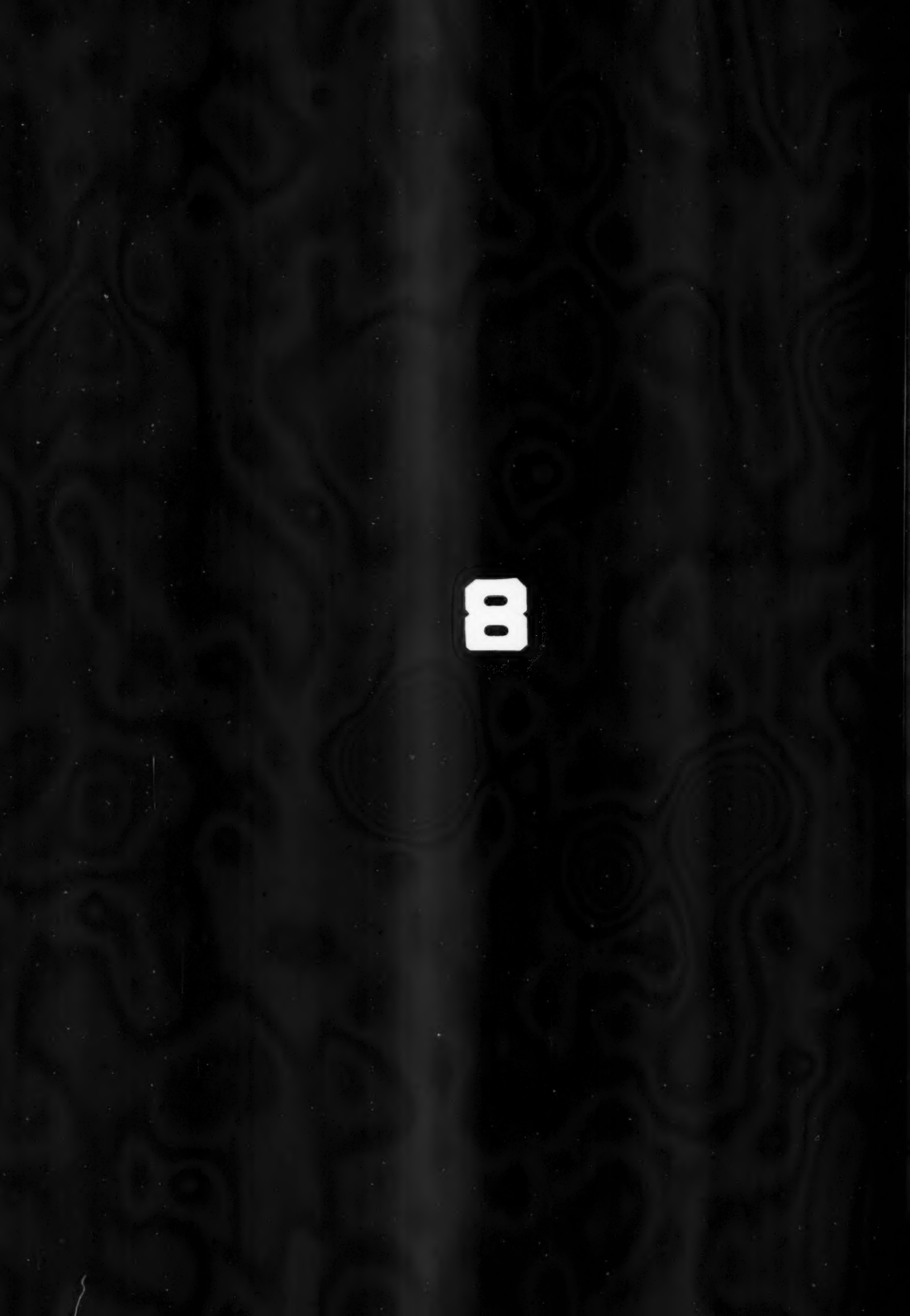

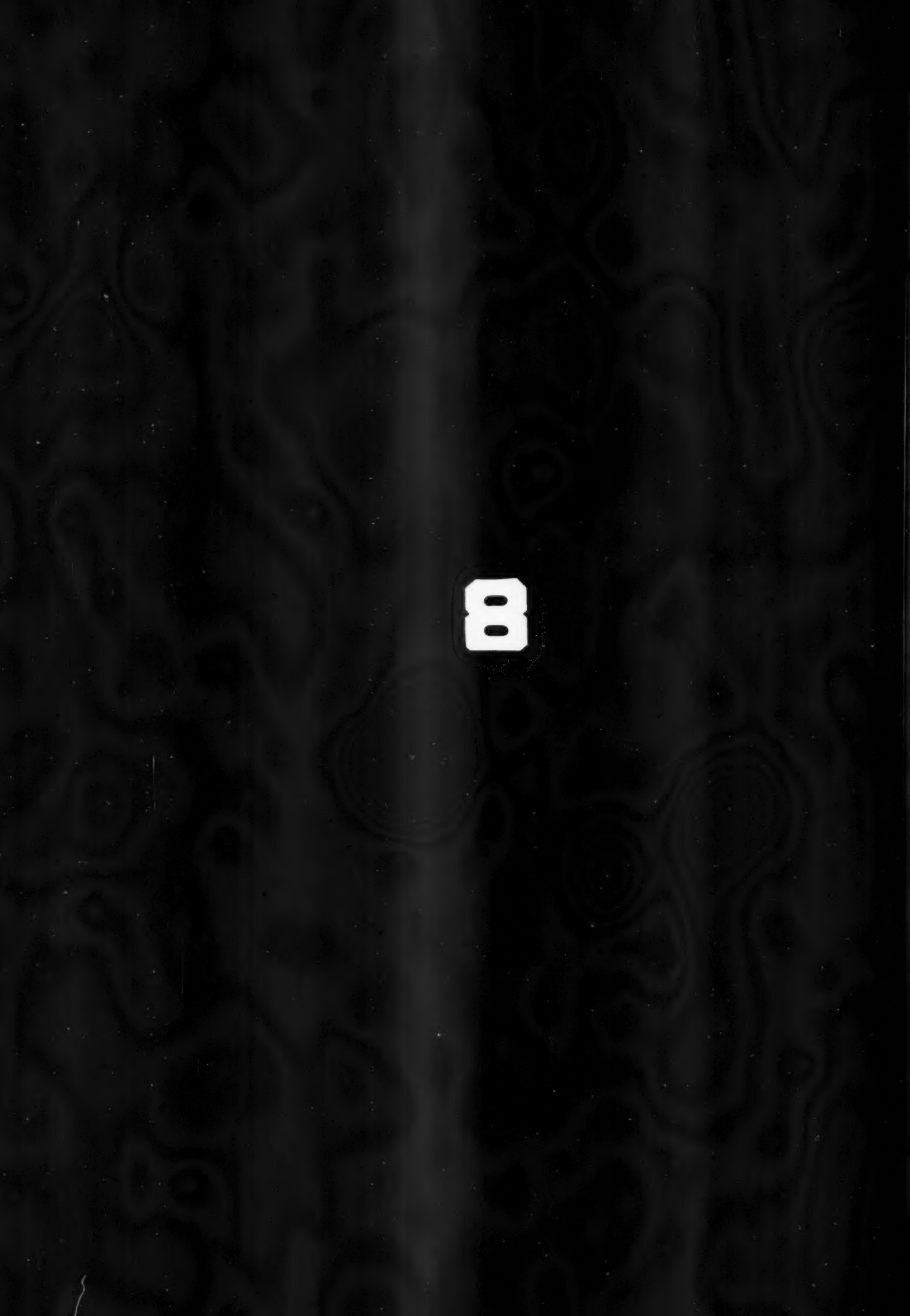

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Shadows and Straws

THE NEBRASKA STATE Capitol Competition, the program for which was commented upon in these columns last month, was won by Bertram Grosvenor Goodhue. The report of the jury, published elsewhere, recites the reasons which determined the choice and likewise explains why the making of the decision was a much more intricate and difficult task than in a competition based upon a rigid program of requirements. It is a fact which marks this competition as an interesting moment in the history of American architecture. It was carefully designed to give the widest possible scope for the imaginative mind, and to free the competitors to the fullest extent from any hampering restrictions, yet it did not permit the factors of cost to be ignored. Also it is to be remembered that only the architect has been chosen. The building still remains to be designed after further intimate considerations of the requirements in collaboration with the Nebraska Capitol Commission.

So radical a departure from the established precedent for state capitols will, of course, invite much diversified comment. But Mr. Goodhue's genius is already so well established that his friends will have no misgivings over the fact that under his guidance the state of Nebraska is to undertake a quest almost unparalleled in its architectural interest.

THE BUILDING INDUSTRY in the United States is at present the subject of wide speculation. So many factors are involved aside from the actual industry itself that there are very many minds as to what the difficulties are or what is best to be done about them. Mr. Bright's statement, in this issue, attempts to go deeply into the problem and is predicated upon a long view into the future, even though it wholly envisages both past and present. Possibly it is worth while, at this moment, to recall the words of John Stuart Mill, uttered in 1867:

"If we wish men to practice virtue, it is worth while trying to make them love virtue and feel it an object in itself and not a tax paid for leave to pursue other objects. It is worth training them to feel not only actual wrong or actual meanness, but the absence of noble aims and endeavors, as not merely blamable, but also degrading: to have a feeling of the miserable smallness of mere self in the face of this great universe, . . . the poorness and insignificance of human life if it is to be all spent in making things comfortable for ourselves and our kin and raising ourselves and them a step or two on the social ladder. Thus feeling we learn to respect ourselves only so far as we feel capable of nobler objects; . . . to sustain ourselves by the ideal sympathy of the great characters in history, or even in fiction.

"Now, of this elevated tone of mind the great source of inspiration is poetry, and all literature so far as it is poetical and artistic. We may imbibe exalted feelings from Plato or Demosthenes or Tacitus, but it is in so far as those great men are not solely philosophers or orators or historians, but poets and artists. Nor is it only loftiness, only the heroic feelings that are bred by poetic cultivation. Its power is as great in calming the soul as in elevating it—in fostering the milder emotions, as the most exalted. It brings home to us all those aspects of life which take hold of our nature on its unselfish side.

"I have spoken of poetry, but all the other modes of art produce similar effects in their degree. . . . There is a natural affinity between goodness and the cultivation of the beautiful, when it is real cultivation and not a mere unguided instinct. He who has learnt what beauty is, if he be of a virtuous character, will desire to realize it in his own life—will keep before himself a type of perfect beauty in human character, to light his attempts at self-culture. There is a true meaning in the saying of Goethe, though liable to be misunderstood and perverted, that the beautiful is greater than the good; for it includes the good and adds something to it; it is the good made perfect, and fitted with all the collateral perfections which make it a finished and completed thing.

"Now, this sense of perfection, which would make us demand from every creation of man the very utmost that it ought to give, and render us intolerant of the smallest fault in ourselves or in anything we do, is one of the results of art cultivation. No other human productions come so near to perfection as works of pure art. In all other things we are, and may reasonably be, satisfied if the degree of excellence is as great as the object immediately in view seems to us to be worth; but in art the perfection is itself the object. If I were to define art, I should be inclined to call it the endeavor after perfection in execution. If we meet with even a piece of mechanical work which bears the marks of being done in this spirit—which is done as if the workman loved it, and tried to make it as good as possible, though something less good would have answered the purpose for which it was ostensibly made—we say that he has worked like an artist. Art, when really cultivated and not merely practiced empirically, maintains, what it first gave the conception of, an ideal beauty, to be eternally aimed at, though surpassing what can be actually attained; and by this idea it trains us never to be completely satisfied with imperfection in what we ourselves do and are: to idealize, as much as possible, every work we do, and most of all our own characters and lives."

Where Goes the City Planning Movement?

IV. THE CONFUSION OF VIEW-POINTS

By FREDERICK L. ACKERMAN

ANY discussion of the general aims of City Planning is almost certain to run off directly into a highly technical consideration of types of Plans, street classification, and considerations of a technical nature. Failing to run in this direction, it starts off into a very jungle of view-points and gets itself lost almost immediately. This is not pointed out as a characteristic peculiar to City Planning discussions; as discussions go, those on City Planning run fairly true to form.

For the moment we may well avoid highly technical considerations, important as they may be: the question relates to the state of confusion referred to as getting "lost in the jungle." No more than a superficial examination of Reports of Conferences and of the literature relating to the subject of City Planning discloses the great variety of view-points from which subject is considered; also, that the various groups engaged in the Movement are working somewhat at cross purposes. Because of this condition, it therefore seems pertinent very briefly to make note of what constitutes the various view-points as they have been set forth by the spokesmen, representative of the several groups. All that is here presented is no more than a rough outline of attitudes which when combined constitute what is spoken of as the City Planning Movement. No attempt is here made to arrange them in an order suggesting their relative importance; they are arranged at random.

The Architectural Interest

It is difficult to select a single word or phrase descriptive of a complex interest or activity. But for the purpose, the term *Architectural* may serve as well as any other to describe that view-point which concerns itself with the physical arrangement or design of the community. By the use of this term it is not implied that it is a view-point alone peculiar to architects: the term is merely used to suggest that view-point from which the problem is approached by those to whom the term City Planning immediately suggests "form," "arrangement," or "composition;" or to whom the term is ever associated with the "art of design." Nor is it implied that those who view City Planning from the *architectural* view-point omit altogether considerations of a social, economic or a utilitarian nature; it is rather that those who view the City Planning problem from this particular angle seek to achieve whatever results are deemed desirable by education, stimulation of appreciation, persuasion, or more accurately, by "selling the idea"—to use a current phrase of good descriptive value. This view-point seeks to achieve a more orderly-arrangement of physical *plan* by "selling the idea" for what it is worth; and hence it is that considerable emphasis—I am inclined to say entire emphasis—is placed upon the pecuniary advantage which it is promised will accrue to individuals through the general adoption of the idea. City Planning is advocated because it is a "business proposition." Art pays!

The technique through which the hoped-for-results are sought is very largely that of graphic "presentation" of one sort or another. Hoped-for-results within this range of view naturally include a great variety of ideas as to what consitutes the adequate urban center. Ideas range all the way from a well ordered mechanistic "factory town" built upon "practical" or "engineering" lines, to the "city beautiful" arranged (of course) economically but generously supplied with amenities and plenty of architectural paraphernalia of the sort spoken of by some people as "conspicuous waste."

Selling the Idea

As has been suggested, the spokesmen for the City Planning movement who hold to this point of view seek to achieve their hope by selling their idea of the adequately arranged city. Of course anyone will agree that if a good idea may be sold, it is as good a way of disposing of it as any other. But the difficulty which is encountered in the world of reality is that the idea has to be sold to no other than the spokesmen of that economic system, the material success of which has come about through a policy of standing firm against buying this particular idea. Naturally the idea has not found many purchasers, although it is highly spoken of; and so the spokesmen of this point of view continue to hope that their well presented Plans and Reports will eventually take shape in reality and thus will the Problem of City Planning be solved. And so we go on writing report after report hoping for the best.

This point of view,—this attitude toward the "problem" fails to take account of the fact that the condition of chaos which now exists in our urban centers is the direct result of the working of our economic institutions. It likewise fails to take into account the fact that to sell the idea to the spokesmen of these economic institutions which in turn control the affairs of the community, the idea must

be so presented as to make plain that it will be to their advantage to buy. Hence to give it the character of a good buy it must be shown that the idea will work to the advantage of those very economic institutions, the unrestricted working of which have created the present physical mess.

Obviously then, this view-point must avoid conveying any suggestion that any material modification in form or manner of growth of our material environment would necessitate a corresponding change in the operation of our economic institutions. It would not appear that the spokesmen of the City Planning movement, holding to this point of view, are likely to accomplish much,—not very much.

The Mechanistic Interest

Another view-point, making contact here and there with that spoken of above as the *Architectural*, may be referred to as the *Mechanistic*. The spokesmen of the Movement who consider City Planning from this view-point are eminently practical; they seek only the efficient city. To them the city beautiful is a red rag. They stand with their feet firmly planted upon conditions of the present and they seek to solve all problems by new street arrangements, highly intricate systems of transportation and complicated works of engineering. To these the urban center is a bit of mechanism; the more complex and intricate the greater their enthusiasm; they take as keen delight in a mess as a boy with a clock case full of wheels. These spokesmen have a ready sale for their ideas; for they are the municipal tinkers; their job is to oil up the mechanism and supply odd parts. But it is not to be expected that those engaged in such matters could well afford to make any very penetrating inquiry into why it is that they are kept so busy.

The Legalistic Aspect

There is a third view-point which overlaps somewhat the two already considered. This third view-point may be spoken of as Legalistic. It is hardly necessary to define this term. The majority of those who contribute to City Planning from this view-point are engaged primarily in finding ways and means of bringing about the hoped-for result by legislative enactments which would extend the application of a rather indefinite force called police power which, in turn, must always be exercised within the limitations imposed by our constitution and sundry fundamental political documents.

This is a very delicate matter. Every problem, every situation presents itself as a dilemma. The problem confronting those who are seeking to secure gains through legislative enactments may be stated somewhat as follows: The established system of law and custom has permitted (some would urge that it has brought on) the development of our material mal-adjustments. Yet what these legalistic spokesmen set out to do is to modify the laws, while insuring that the modifications shall in no wise conflict with the standards and principles which underlie them. This is not an easy task; for underlying these laws and customs which it appears important to modify, stands that foundation which we speak of as Natural Rights. "The system of Natural Rights is a system of personal rights, among which the rights of ownership are paramount; and among the rights of ownership is the right of free disposal and security of ownership and of credit obligations."

The task confronting the legal advisors of the Movement is to hack off tiny bits of this foundation when no one is looking in the hope that out of the little pieces they may be able to start a new foundation for the structure of Community Rights. This requires patience and a vast amount of skill on the part of the advocates of change involving such fundamental matters. For it is notorious that if the new foundation should become sufficiently strong to be of real service, the old would become correspondingly weak. It is not to be assumed that very much will be accomplished by the present method of approach since as yet it is necessary to frame our legislative enactments around the principles which are drawn upon to support and sustain those institutions, the working of which have brought on the present state of inadequacy and mal-adjustment in our urban centers.

The Economic Impasse

Of course legal mechanism and legal technique are essential to the actual working out of any plan; but it appears upon no more than a superficial examination, that the legalistic structure which already has been erected around this Movement aims primarily at checking our system of Natural Rights at approximately that point where no one could possibly be seriously interfered with by having his rights restricted. This may seem like an unfair statement of the case; but the accuracy of the statement may be clearly demonstrated by merely noting the arguments invariably mustered to support proposed laws and regulations of various sorts. Zoning is defended because it stabilizes property values; the zoning movement in New York was launched after it had been discovered that control over building was needed to insure property owners in certain shopping districts against further losses, which losses had been occasioned by the free movement of industry. This is not cited as an argument against laws and zoning regulations; it is merely pointed out to show how it is that under the working of the present economic system, any regulatory act which interferes materially with the free working of that system is likely to be ruled out of court unless it can be clearly de-

monstrated that no one will lose any prospective pecuniary gain by its enactment.

The Evangelical View

There is still another view-point which appears throughout the literature and at the Conferences above referred to. This view-point may be described as the *Evangelical.* It is compounded from all of the points of view described above and it seeks to bring about a better condition within our urban centers by a procedure so quiet and orderly that no one will be aware of a change. Those who hold to this view-point are largely people connected with civic organizations of one sort or another; and their function is largely that of distributing propaganda as how best to administer palliatives. On the whole this point of view does not concern itself at all with the working of our economic institutions. It seeks "to do good" and it seeks to do it through extending the exercise of police power. The spokesmen holding to this point of view are engaged primarily in dealing with symptoms.

There is still a fourth view-point which is not confined to those directly interested in the Movement. This brings us back to the first article in the *series since this last view-point has to do with that attitude there considered under the heading "normal tendencies." We now have to consider the Public view-points. City Planning gets a public hearing now and then simply because there have been developed within our urban centers certain physical problems of such a character or importance as to demand attention by those who are interested in property.

What Every Man Wants

Now the point of view referred to as that of the public is a very complex affair. It has its roots in our concept of Law and Order, and it accepts without question the idea that our entire bundle of social, economic and political institutions must be retained and preserved simply because they have been created by us. That they should be preserved is more important than to discover whether or not they have been operating to defeat our purposes. This is the point of view which records itself in our complex, ugly, mechanistic environment.

It is not my intention here to go into a detailed statement as to what constitutes this view-point; it may be described or suggested by the phrase: "I want what I want when I want it." This is probably as accurate a description as need be used to convey the thought which underlies the Public's attitude of mind toward the building of cities. For it is the actual carrying out, in reality, of this fine sentiment on the part of individuals and institutions that has created our muddled material and social environment. So far as the People are concerned, or in so far as they have consciously worked for the present state of things in our urban centers, the phrase—"I want what I want when I want it"—may be set down as the people's first and foremost fundamental principle of City Planning. This may be placing the purpose of the people in a rather unfortunate light, but it is safe to say that anyone who may have had occasion to observe the reaction of individuals or of those in control of our various institutions, when any action has been suggested toward working out a more adequate environment, will agree that only such modifications of laws or physical arrangements as in no wise conflict with this sentiment are at all likely to be accepted by anyone.

Since this may be set down as the opinion which passes current, it would not appear that for some time to come there was very much hope of our moving off in another direction than that which we have been following. Such a conclusion is discouraging but "for some time to come" is a rather indefinite expression and therefore it is that it may be well for us to give consideration to a plan of action which would seek to advance the date of "some time to come" to an appreciably earlier one by really dealing with the causes which make for our condition of mal-adjustment.

All this is stated by way of pointing out that there are many and divergent aims within the Movement and that there is no very definite plan of action which gives promise of more than trivial gains here and there. Taken as a whole, the City Planning Movement seeks to accomplish its aims through the administration of palliatives,—palliatives of such a character as would leave our institutions which have brought about the present conditions of chaos working at approximately their full force. On the face of it, it would appear that if anything of importance is to be accomplished by the Movement, those forces which make for the present state of things would have to be dealt with.

The dominating force which makes for the present state of things is our industrial system, our system of modern credit economy, controlling industry carried on by the machine process—sometimes referred to as the "Capitalistic System" or "Modern Business Enterprise." No attempt may be here made to show how the spirit of modern business enterprise dominates and controls the acts of individuals as well as governments. How this system is rated may be suggested by a quotation from an editorial in a recent issue of the Metropolitan: "You can not be against the capitalistic system and still for America; you can not apologize for that system or feel ashamed of it and still be a good American; you can not indeed be a good American, in your sense of being loyal to American traditions

*See the Journal for December 1919.

unless you are proud of the capitalistic system." This may be slightly overdrawn in a zeal to defend our attitude toward the driving force in American life. But it does suggest why it is that the City Planning Movement stands off from making any investigation into the causes which make for those conditions which it sets itself up to modify and which have given us our material environment just as it is.

I am not writing with the thought in mind that thereby the spokesmen of the Movement will come to modify their point of view. I merely insist that if the movement is to get anywhere, that a new viewpoint must be brought to bear upon the study of the Problem.

Owing to the fact that the forces which dominate and give direction to modern life are the same which animate modern business enterprise or the capitalistic system, it would appear that any attempt to deal with the situation of material mal-adjustment and chaos would require an insight into the workings of these institutions such as would be gained by an inquiry which approached the question from the view point of economics and psychology. The suggestion of an approach from the view point of economics is not to be interpreted as implying the view point of the hedonistic school or the economics of Adam Smith. What is intended, specifically, is that our inquiry into the theory of the modern urban center should approach its work from that view point as regards the scope and nature of the inquiry suggested in Veblen's "The Theory of Business Enterprise," or "The Instinct of Workmanship," or in Tawney's "The Sickness of an Acquisitive Society."

Of course the argument upon which this statement is based may not be set forth briefly; but the premise upon which it is based may be stated somewhat as follows: Our modern material environment (particularly our industrial or urban centers) has come to be what it is through the operation of that system referred to as modern business enterprise, (in which the factor bearing most directly upon the question in hand is investment for profit). Since this institution stands responsible for all that we now have by way of material equipment, institutions and even political structure, and since it forms the axis around which our habit of thought revolves; and since it is therefore responsible for the mal-adjustments, it would appear that an inquiry into the working of this complex institution would constitute the first step looking toward the solution of the Problem. The City Planning Idea, when put in simple elemental terms, is a live and let live idea. It stands for order, arrangement, conservation, a reasonable distribution of population; it appears as an Ultimate Good. But it happens that these aims are not the aims of modern business enterprise and investment for profit. This of course will be denied by the spokesmen of modern business enterprise, but drawing upon the evidence at hand, we note that, *e. g.*, industry operating under the system of price competition and the wage system seeks a snug place of abode in a highly congested area. Or the Capitalistic conception of the *use* of land is that land was created primarily to serve as the ideal basis for carrying on a system of investment for profit. This likewise makes for congestion. Under the working of the system, land is used for the purpose of creating unearned increments or free income.

Modern business enterprise revolves around the idea that the rewards for investment in an activity shall be returned quickly, and returned in terms of price. It is not interested in a system of credit nor in a system of production from the operation of which the community is certain to gain ultimately. Production is actuated by the prospect of quick turnover; this idea applies to the entire range of activities and things with which modern business enterprise concerns itself. Its policy is to scrap machines, buildings, cities, and men, by a speeding up process driven on by a system of investment for profit. As material evidence of this statement, we may note the ugly, temporary make-shift character of the modern urban center. Where does one find any evidence that the system works directly toward an Ultimate Good?

Again will it be urged that economics and the organization of production is not a matter to be dealt with by the spokesmen of the City Planning Movement. A vote would probably reveal that attitude. If it did, it would likewise reveal that the spokesmen are laborers engaged by the system to tinker our material civic structures which arise out of its workings. And further it would reveal that the real spokesmen of order and net gain in terms of the entire community are really those economists who are attempting to demonstrate that this system must be reorganized in order to render impotent those predatory forces which make for our conditions of mal-adjustment, and which stand as immovable barriers against any change which would more likely result in net gain to the common man.

But we have spoken of the conscious interest in City Planning as the City Planning Movement. Thus far what has been stated relates primarily to present day concepts. But present day concepts are always undergoing a change; it therefore seems pertinent to examine briefly into the slight change which ought to be rated as affecting the Movement a with view of discovering if possible where the Movement is going.

(To be continued.)

Greek Design

From a Paper Read before the Royal Institute of British Architects, Monday 23rd, February, 1920, by Mr. Jay Hambidge.

DURING the year 1902 I had the advantage of many conversations with Mr. Francis Cranmer Penrose on the subject of Greek architecture, and he permitted me to take his original notes and drawings on the Parthenon and use them in my London studio for many months. Together we discussed his then pet subject, the Ionic Volute, from many standpoints. I couldn't agree entirely with his hypothesis that the spiral was probably produced by unwrapping a string from a wooden cylinder cut in the form of a stepped cone. Following a conversation on this point I visited the British Museum next day and found compass marks on the unfinished eye of the volute from the column head from Ephesus. These marks were arranged on octant lines drawn through the centre of the eye They appeared so clean and unweatherworn, however, that I suspected they might have been made by modern investigators. An Ionic head from Priene, however, well weatherworn, showing the same condition as the head from Ephesus, convinced me that the volute curve was produced by octant circle arcs, at least during later classic days. Photographs and squeezes were made for me of these two "eyes" at the time, but, as the find was a minor part of my general investigation of planning methods, I did not publish it.

Mr. Penrose was present when I read my first paper on Symmetry before the Hellenic Society, shortly after he read his paper on the volute. During the discussion which followed he took advantage of the occasion to assure the members of the Society that he was familiar with my method of procedure, declared that it was scientific, hoped that the matter would not be permitted to languish, and gave the method unqualified endorsement. Many times during my conversations with the great archaeologist he expressed his regret that British architects of the time were so out of touch with Greek design. Once he said, "I give you warning that it is almost impossible to revive interest in classic architecture in England." Since that wonderful summer of eighteen years ago I have critically examined the work of most Greek archaeologists, but I have never found anything surpassing, or even equalling, the work of Francis Cranmer Penrose. I am astonished that his name is not more often mentioned by modern English writers on the subject. There is an abundance of citation of German authorities, but of Penrose very little. However, it remained for a German to refer to his work at Athens as "the pearl of archaeological research." (See Prof. Wm. H. Goodyear's *Greek Refinements*.)

When we measure the greatest length and the greatest breadth of a Greek temple, a Greek unit of pattern, a Greek bronze or a Greek vase of the best period, we obtain the end and side of a rectangle. The lines which we thus obtain are almost always incommensurable or unmeasurable one with the other. As areas, however, these rectangles possess a fascinatingly curious commensurability. They are extremely easy to construct and, moreover, belong, or may be reduced, to one or two classes. Further, we almost invariably find that the details of a Greek design are logical parts of its containing rectangle. In fact this is the acid test by which we determine the grade of planning knowledge possessed by the classical designer. For example, if we measure the greatest height and the greatest width of a fine vase in bronze or clay we find that the width of the foot, its height, whatever definite sub-divisions there may be, the width and height of the lip, the height and width of the neck, and, in the great majority of cases, the ornamental band usually found underneath pictorial compositions, are all logical and direct sub-multiples, of a peculiar kind, of the containing or overall rectangle. If this doesn't prove to be the case, then the example is excluded as an exception.

When Greek designs were first measured the astonishing fact was revealed that the measured lines were incommensurable—*i. e.*, one line could not be divided one into the other. In later days certain enthusiastic archaeologists claim to have discovered round numbers in some Greek measurements. It has been claimed, for example, that the stylobate flank was exactly 200 Olympic feet. Without questioning the accuracy of the modern interpretation of the Olympic foot, or accepting it as established, the fact remains that other lines of the ground plan, such as the facade width, the enclosing or sub-dividing lines of the cella, etc., cannot be divided into this so-called line of 200 feet. But, if we take this same temple plan and consider the rectangle it furnishes, also the rectangle of the plan of the cella and the column arrangement, we see immediately that they belong to a class of rectangular shapes which seem to have been well known to Greek designers for generations. Moreover, we recognize at once that the architect of the Zeus temple used a different type of rectangle from those we find on the Acropolis at Athens. Theoretically we should find round numbers in some shape in Greek design, but it is not likely that we shall find them more than once or twice in any specific example.

This is a very astonishing situation. As practical men, we know that, before works can be carried out by workmen, some measuring method must be employed which produces commensurabilty. For this purpose we use the foot or the metre, and divide it into even fractional parts. An exhaustive investigation of classic design shows clearly that in the early part of the sixth century B. C. Greek craftsmen were using a measuring method wherein commensurability of lines was an essential feature. And that some time during this century a change was made from the older to a newer system. The essential base of this new method was incommensurability of lines, but measurableness of area. The first system depended upon a unit of some sort. It is not necessary for us to know what this unit was; it may have been a cubit, a foot, a hand, or something quite arbitrary The point to bear in mind is that measurableness of line or area will always remain measurable, no matter what the unit may be. A diagonal to a square in relation to a side, for example,

will remain a diagonal to a square whether we use a foot, a metre, or any other length unit, or whether we fix it arbitrarily by construction. It is because of this fact that we are able to create an instrument for analysis which will determine accurately the character of a measuring scheme in any terms we may decide to select. The determination of the character of a measuring method in design in reality means the determination of the grade of *symmetry*, using the word in its Greek sense of analogy or relation of part to whole.

In this connection it is advisable to stress the point that design means very much what the word implies—that is, *intention*. Before we recognize a design as such there must exist in it an arrangement of elements of some sort which bear to each other and to the whole some degree of relationship. This may be conscious or unconscious on the part of the creator of the design. That there was intention on the part of the designer to make this relationship depend upon a definite proceeding, at certain periods of man's design history, we know, because treatises written upon the subject, as well as plans themselves, have survived. For the purpose of determining the grade of symmetry in a design, however, there is nothing better than the design itself, providing that we have the proper instrument for analysis. Recognition of the necessity for such an instrument led the writer, some twenty-three years ago, to undertake an examination of the bases of symmetry in nature. Five years later, in the autumn of 1902, a preliminary paper upon the subject was read before the Hellenic Society in London. At this time a minor phase of symmetry phenomena had been formulated. Later, during the winter of 1913, the entire scheme was developed and arrangements made for the reading of a concluding paper before the same Society, during the autumn of 1914. The coming of the war caused a postponement until 1919.

Examination of natural symmetry developed the fact that there were but two phases of this phenomena which could be of use to design. One of these is observable in the crystal and in other regular pattern forms. The snow crystal is an excellent illustration. Because of certain characteristics this was given the name of *Static Symmetry*. The other phase is to be seen in the phenomena of leaf distribution in plants, and in the curious assymmetrical balance of form in the shell. This, because it appeared to be the orderly arrangement of elements in growth, was given the name dynamic symmetry.

Examination of man's design efforts developed the striking fact that there existed a parallel between these and nature. It was found that the static type was more or less spontaneous; was indeed the type used consciously or unconsciously. This type, very often, is apparent by inspection, and in such cases it is not necessary to measure a design. It is difficult to believe, however, that the *dynamic* type could be employed unconsciously. When the general principles inherent in these two types of symmetry had been worked out, and their operating technique developed, it was found that the static was the type existing in the design products of all nations excepting the Egyptian and the Greek; also that it is historical that the Greeks had practically exhausted many phases of this dynamic type, probably as early as the beginning of the fifth century B. C.; that, as early as the fifth, some think the eighth, century B. C. the Hindus were familiar with many of the basic facts of dynamic symmetry. We learn this from an early Hindu work which has survived termed Sulvasutras. "The term *Sulvasutra* means 'the rules of the chord,' and is the name given to the *Kalpasutras*, which treat of the construction of sacrificial altars." Those curious to read about this interesting matter should consult *Indian Mathematics*, by George Rusby Kaye, Calcutta and Simla.

The Indian phraseology in this old work, in the light of dynamic symmetry, is of curious interest. Some of it is:

(1) A chord stretched across a square produces an area of twice the size.

(2) Take the measure for the breadth, the diagonal of its square for the length; the diagonal of that oblong is the side of a square the area of which is three times the area of the (generating) square.

(3) The diagonal of an oblong produces by itself both the areas which the two sides produce separately.

(4) This is seen in those oblongs whose sides are three and four, twelve and five, fifteen and eight, seven and twenty-four, twelve and thirty-five, fifteen and thirty-six, etc.

The oblongs described in (1) and (2) are root-rectangles, and are identical with those we know, from history, that the Greeks worked out. The Greek phraseology, however, was "the determination of a square which should be any multiple of a square on a given linear base" (see Allman's *History of Greek Geometry*, from Thales to Euclid).

The oblongs described in (3) and (4) are the triangles of history by which the rope-stretchers established right-angles and "corded the temples." The 3 and 4 oblong has 5 for a diagonal, 12 and 5 has 13, 7 and 24 has 25, etc., etc. It will be noted that the Hindu uses the term oblong. This immediately suggests the Pythagorean rule for the determination of right-angles by numbers, beginning with odd numbers. Take an odd number, say 3, square it and subtract unity, divide the result by 2: 3 multiplied by 3 equals 9, and 9 minus 1 equals 8, 8 divided by 2 equals 4, the second term; add unity, to obtain 5. This is the celebrated 3 4 5 triangle of Pythagoras, which has been in use for fixing right-angles from early Egyptian days to the present. Later Plato supplied a rule for finding right-angles beginning with even numbers (see Ballo, *Short History of Mathematics*). I have seen a carpenter in America establish a right-angle by a rope divided into twelve parts, and lay out his plan on the ground for a garage. Asked for the meaning of the proceeding, he replied that he supposed everybody knew the principle; he had known it since apprentice days. The historical method was to ake a rope divided into twelve units; place three of these along an established line, four the other way, and permit the remaining five units to form the hypotenuse. This consideration of the right-angle leads us immediately to the crux of the matter of symmetry in Egyptian and Greek design, and one of the most interesting glimpses of ancient craft practice is furnished by the etymology of a Greek word. An explanation of this point will be found in Gow's *Short History of Greek Mathematics*.

"The Greek philosopher Democritus is quoted by Clement of Alexandria as saying: 'In the construction of

plane figures (lit., composition of lines), with proofs no one has yet surpassed me, not even the so-called Harpedonaptæ of Egypt.' It was evident, of course, that these Harpedonaptæ were famous geometers, but Professor Cantor has first pointed out that their name is compounded of two Greek words and means simply 'rope-stretchers.' He explains their function in the following way: 'There is no doubt that the Egyptians were very careful about the exact orientation of their temples and other public buildings. But inscriptions seem to show that only the north and south line was drawn by actual observation of the stars. The east and west line, therefore, was drawn at right-angles to the other. Now it appears from the practice of Heron of Alexandria, and of the ancient Indian and probably also the Chinese geometers, that a common method of securing a right-angle between two very long lines was to stretch around three pegs a rope measured into three portions which were to one another as 3 :4 :5. The triangle thus formed is, of course, right-angled. Further, the operation of rope-stretching is mentioned in Egypt, without explanation, at an extremely early time (Amenemhat I).' "

Sir Norman Lockyer, in his *Dawn of Astronomy*, furnishes us with some pertinent Egyptian wall inscriptions bearing upon this matter of "cording the temple." It seems to have been an important ceremony, and the king, accompanied by the appropriate goddess, drove the pins with a golden hammer. The historians tell us that the Egyptians were regarded by the Greeks as masters of figure dissection. From the above the rope-stretchers must be included in this class. The present investigation of design bases suggests unmistakably that these rope-stretchers were equivalent to the modern surveyor. Hereodotus tells us that the annual overflow of the Nile destroyed property boundaries and created much confusion and dispute. To re-establish these boundaries frequent re-survey was necessary. If rope-stretching was a recognized science as early as the time of Amenemhat I. the beginning of the practice must have long antedated that period. It must have taken many centuries to develop skill so publicly recognized.

Dynamic symmetry shows us that it must have been out of some such practice as rope-stretching or surveying that the basic ideas of correlated or formal design in both Egypt and Greece developed. We may take any one of the right-angled triangles which are obtainable from the rules of Pythagoras and Plato and obtain readily, and with the utmost accuracy, all the proportions which we find in classic design.

It will probably have occurred to the audience that dynamic symmetry, in its essentials, is simply a method of measuring. This is indeed true. Design analysis in general shows that the spontaneous method of measuring is linear. In our day we use the linear unit; but this method produces static symmetry of the most commonplace kind. A much better grade of the static variety was used during the Middle Ages. The facts appear to justify the assumption that some genius, undoubtedly in Egypt, but possibly in Greece, after a linear scheme had been in use for some time, made the extraordinary discovery that another method of measurement was possible; that a diagonal to a square, used in relation to a side, produced shapes which, while incommensurable as lines, were delightfully measurable as areas. The fascinating series of root-two shapes which Greek design supplies rest upon this side and diagonal relationship. Later still some other observant designer hit upon the idea that the diagonal to two squares, in relation to the side of one of the generating units, supplied a much more powerful and flexible method of area measurement. This latter method is the most satisfactory scheme so far discovered for correlating the elements of design. To us the interesting aspect of the matter lies in the fact that a diagonal to two squares is the base of the phenomena of leaf distribution in the vegetable world. Modern botanical research has sufficiently established this.

Owing to his understanding of a method of measuring by areas so simple—indeed, that a string and a few pins or a string merely held in the two hands is all the instrument necessary—the Greek designer had knowledge of an infinite series of remarkable shapes entirely unknown to the modern designer. We may use strong emphasis on this point because extraordinary precautions have been taken to ensure accuracy of results. The Parthenon at Athens, of course, stands on Penrose's measurements. When we consider the ground plan of this building as a rectangular area (this area must include the Euthynteria or lowest levelling course), and divide the end into the side, we obtain a ratio which is immediately recognizable as belonging to the series of dynamic shapes mentioned. Penrose was most painstaking in his survey of this building, so we may take his figures, and without making a drawing or diagram prove the correctness of the measurable area scheme by a little arithmetic. When we follow out the logical process of subdivision, which is a peculiar property of this particular rectangle, we find that every detail of this ground plan forms part of an arrangement wherein the basic design idea is similarity of figure. The main motive is a square plus an area obtained from a dia-diagonal to two squares.

The principle by which the subdivisions are obtained depends upon establishing a reciprocal to the major area. This idea of a reciprocal to a shape seems to be quite unknown to modern design, but there is overwhelming evidence that Greek designers thoroughly understood it. The division of the area of the Parthenon ground plan results in an arrangement of similar figures in which the column centering plays the most important part: this includes the relationship of the neighboring columns to the angle columns. The error throughout is the error of workmanship, as Penrose's measurements disclose it. After the ground plan we may take the facades and all their details, such as columns, architave, triglyph, and metope or pediment. Further, we may unfold the buildings—*i. e.*, place the front and side elevations, with half the roof on either side, in two-dimensional position on the four sides of the ground plan and obtain another larger rectangle. In this shape every superficial square inch of the exterior of the building may be inspected. This new rectangle will be found to belong to the same base as the rectangle of the ground plan. In other words, the building supplies us with an area theme of a peculiar character. Moreover, it is easily proven that this particular theme has a base in nature.

During the past year and a half Dr. L. D. Caskey, Keeper of Greek and Roman Antiquities of the Museum of Fine Arts, Boston, has devoted his entire time to the preparation of a large volume on the Greek pottery under his care, wherein the whole fabric is scholarly and exhaustively treated in the light of dynamic symmetry. Dr. Caskey's work is corroborative in every detail of the dynamic theory. At the Metropolitan Museum of Art, New York City, Miss G. M. A. Richter, Keeper of Greek and Roman Antiquities, took unusual precautions to obtain reliable measurements. The pottery was first measured in detail by a secretary and a rough sketch made of the example. This material was sent to me at Boston. From these measurements I quickly determined the grade of symmetry of each example. An expert draughtsman, with the assistance of a few specially prepared instruments, made an accurate drawing of the projection of each example. These were also sent to me, the drawings being first inked, so no changes could be made. If these drawings and measurements did not coincide the example had to be reinspected. Later I made an interpretation of the straight line and curve proportions of all the examples. It should be borne in mind that it is not necessary to make a drawing of any example of Greek classic design; a few measurements settle the matter. So far classic design shows something like 80 per cent based upon a diagonal of two squares as a measuring base approximately 10 per cent on the diagonal to one square, 5 or 6 per cent static, the remainder indeterminate.

We obtain the same percentage from the British Museum. I have been gradually obtaining examples of Greek bronzes of the best period, both here and in America. The results show even a higher quality of symmetry than the pottery. I stress the importance of the Greek vase because it has developed that this pottery is the only pure architectural pottery. Almost nothing is known about the shapes of this extraordinary fabric, while volumes have been written on the paintings or drawings on them. The Greek vase compels our admiration, and has persisted as an object of rare beauty probably because of its exquisite proportions and shape. The paintings are often inferior. Professor Baur, of Yale University, has pointed out that the Greeks themselves thought thus because we find more signatures of designers than of painters. Edmond Pottier, Keeper of Greek and Roman Antiquities in the Louvre at Paris in 1906, had to say of the proportions found in Greek vases:—

"I will add that the proportions of the vases, the relations of dimensions between the different parts of the vessel, seem among the Greeks to have been the object of minute and delicate researches. We know of cups from the same factory, which, while similar in appearance, are none the less different in slight, but appreciable, variations of structure (n'en sont pas moins differentes par des nuances appreciables de structure) (*cf.*, for example, Furtwangler and Reichold, *Griechische Vasenmalerei*, p. 250). One might perhaps find in them, if one made a profound study of the subject, a system of measurement analagous to that of statuary. We have, in fact, seen that at its origin the vase is not to be separated from the figurine (p. 78); down to the classical period it retains points of similarity (*accointances*) with the structure of the human body (Salle). As M. Froehner has well shown in an ingenious article (*Revue des Deux Mondes*, 1873, c. civ, p. 223), we ourselves speak of the foot, the neck, the body, the lip of a vase, assimilating the pottery to the human figure. What, then, would be more natural than to submit it to a sort of plastic canon, which, while modified in the course of time, would be based on simple and logical rules? I have remarked (*Monuments*, Piot IX, p. 138) that the maker of the vase of Cleomenes observed a rule illustrated by many pieces of pottery of this class when he made the height of the object exactly equal to its width. M. Reichold (c. 1, p. 181) also notes that in an amphora attributed to Euthymides the circumference of the body is exactly double the height of the vase. I believe that a careful examination of the subject would lead to interesting observations on what might be called the "geometry of Greek ceramics." (E. Pottier, Musee National du Louvre, *Vases antiques*, *III*, p. 659.)

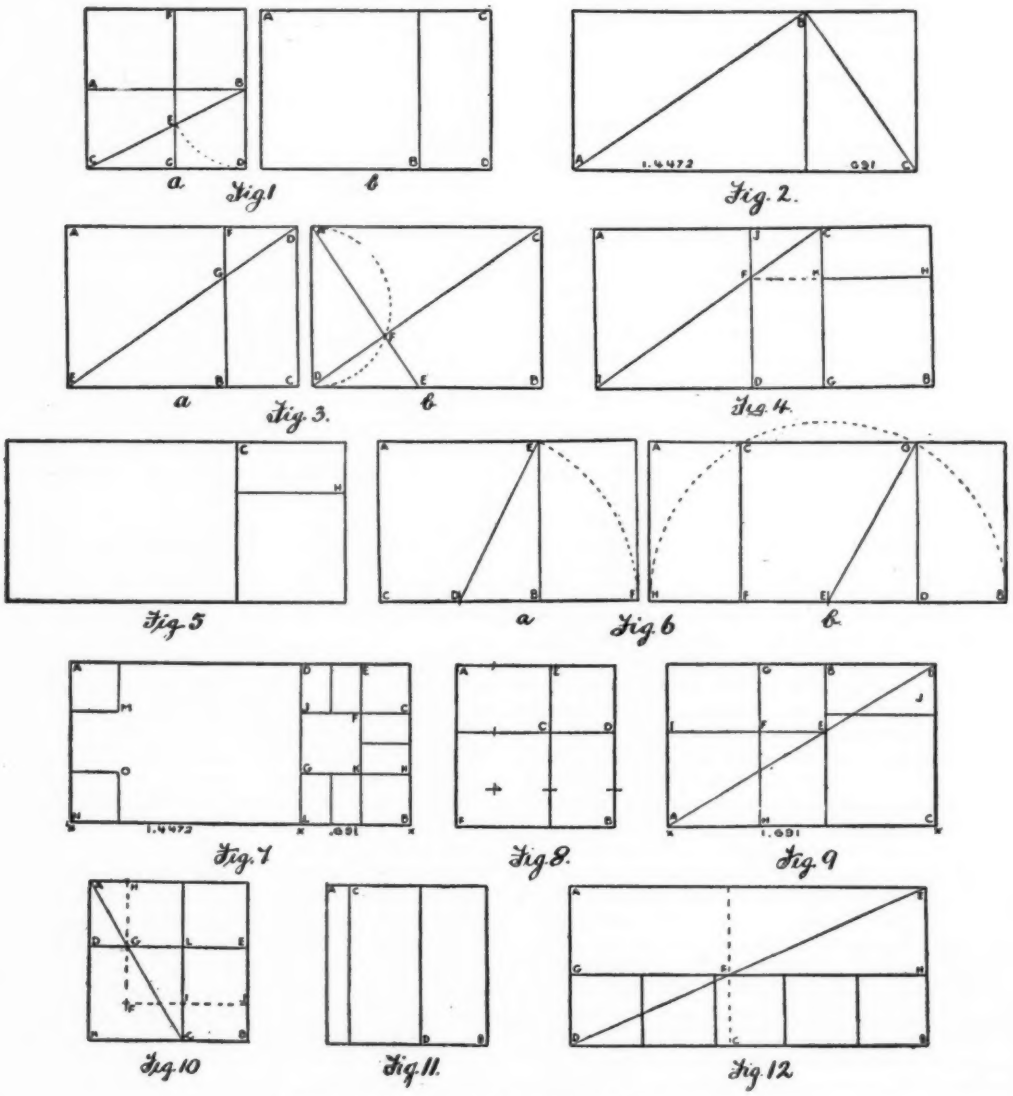
The Parthenon Plan Scheme

The Parthenon plan must be considered as a straight line or rectangular area arrangement. The curves are refinements added after the plan was developed. (See Penrose and Prof. Wm. H. Goodyear.) Dynamic Symmetry shows us that a Greek design must be considered in its totality—*i. e.*, the entire or overall dimensions must be contained exactly in some definite rectangle. For a Greek building these overall dimensions must include the Euthynteria or lowest levelling course. The width of the end of the stylobate on the Parthenon is 101·341 English feet. Penrose gives the width of the three steps as 4·65 feet on one side and 4·67 on the other. The width of the Euthynteria as a small step is 33. This added to 4·65 equals 4·98; to 4:67 it is 5·. For convenience of arithmetical calculation we may assume that 5· is correct. Multiplied by 2 we obtain 10· English feet as the width of the steps on either side of the stylobate. The full width of the end of the rectangle of the ground plan therefore is 111·341 feet. The length of the top step on the flank is 228·254± with 10: added it is 238·154±.

111·341 divided into 238·154 equals the ratio 21·382.

111·341 multiplied by 21·382 equals 238·069, actual error ·045 feet. The actual ratio should be 2·13819±. We have a degree of accuracy here which is difficult to realize in a building built by man.

Students of dynamic symmetry will immediately recognize the ratio 2·1382 as a compound shape composed of two familiar areas which are arithmetically represented by 1·4472 plus ·691. Of the ratio 1·4472 the whole number 1· represents the area of a square and ·4472 is a root-five rectangle. The square root of five is 2·2360 and this number, normally, would be the ratio for a root-five area—*i. e.*, a rectangle the end of which is 1: or unity and the side 2·2360 (N.B.—These areas may be scaled sufficiently close for an ordinary drawing by using a metric scale). In the present case the root-five area is standing on its short end with its side against the side of a square, consequently the side is regarded as unity or 1·. The short end must be in root-five proportion to unity—*i. e.*, the area must be a reciprocal of the root-five area. This notion of a reciprocal is entirely new to modern design, but we have abundant evidence that the Greeks throughly understood its function. A reciprocal of a root-five rectangle—or indeed any root



FIGURES ILLUSTRATING MR. HAMBIDGE'S CONCLUSIONS.

area—may be obtained by dividing the number representing the root into unity or 1·0. A root rectangle always contains an even number of reciprocals. A root-five rectangle contains 5 reciprocals, root-four 4, root-three 3, root-two 2, etc.

2·2360 divided into 1·0 equals ·04472, or 2:2360 divided by 5 equals 0·4472. The ratio 1·4472 is now clear. The simple geometric method for the construction of this area is as follows: Construct a square and bisect the area by the line A B, Fig. 1, *a* [p. 000]. Draw the line B C.

This is a diagonal to two squares. Make B D equal to B E and through E draw F G parallel to B D. The area F D is a root-five rectangle. F G is equal to unity or 1·0 and G D is equal to 0·4472. In Fig. 1 *b*, the root-five area C B is added to the square A B, and A D is a 1·4472 rectangle. The fraction 0·691, because it is less than unity, must represent a reciprocal of some ratio greater than unity. To obtain this ratio we divide 0:691 into 1·0. The result is 1·4472. A reciprocal of a rectangular area is a similar shape to the whole, therefore a 0:691 area is also composed of a square plus a root-five rectangle.

The geometrical method for the construction of a 1·4472 shape plus its reciprocal is shown in Fig. 2. A B is a diagonal to a 1·4472 area. B C is a diagonal to a 0·691 area. The two lines form a right angle at B. General methods for geometrically determining reciprocals are shown in Fig. 3 *a* and *b*.

A C, Fig. 3 *a*, is any rectangle. A B is a square on the end of the rectangle "applied" to the area of the rectangle, and E D is a diagonal which cuts F B, a side of the square A B at G. The line G B is the end of a reciprocal to the major shape. A B, Fig. 3 *b*, is any rectangle, and D C is a diagonal, A F D is a semicircle described on A D, the end of the rectangle. The diagonal D C cuts the semicircle arc at F. Draw A E through the point F. The area A E is a reciprocal and a similar shape to the whole. Diagonals of reciprocals cut diagonals of the whole at right angles and introduce continued proportion into the area of a rectangle. E F is to F D as F D: F A: F C; or E D: D A: D A: A C, etc. A F D is a triangle in a semicircle, and, consequently, is a right-angled triangle.

Referring to the Parthenon ground plan, A B, Fig. 4, is a 2·1382 rectangle, A G a 1·4472, and C B a 0·691 area. A D is a square "applied" to A G, and C I, a diagonal, cuts J D at F. The line F D is equal to G B. Draw the line F H parallel to D B. C D is a root-five rectangle as is also H C. A D, B K are squares. The area C H, Fig. 5, is a root-five rectangle. This area is composed of a square plus two 0·6180 shapes, 1:0 plus 0·618 plus 0·618. This area, represented by the fraction 0·618, is a rectangle which has been given the name, by the writer, of the "rectangle of the whirling squares," because of a certain property possessed by its reciprocals. If 0·6180 be divided into 1·0 the result is 1·6180. The geometrical method for the construction of this shape is shown in Fig. 6 *a* and *b*.

A B, Fig. 6 *a*, is a square. B C, a side, is bisected at D and D E drawn. D E is a diagonal to two squares. D F is made equal to D E. The rectangle A F is completed. This area is a rectangle of the "whirling squares." A C is unity or 1·0, and C F is equal to 1·6180. C B is equal to 1·0, and B F 0·6180. F E is a reciprocal to F A. The square-root of five is 2·2360. If to 1·6180 the fraction 0·6180 be added, the result is 2·2360. In Fig. 6 *b*, C D is a square. D F, a side, is bisected at E and E G, a diagonal to two squares, drawn. E G is made equal to E B or E H. H C G B is a semi-circle; H C, G B are 0·6180 rectangles. A D, B C are 1·6180 rectangles. A B is a root-five rectangle composed of a square C D plus the two 0·618 shapes B G, A F.

A B, Fig. 7, is a 2·1382 rectangle. C D is a root-five rectangle, and D F an area composed of two 0·6180 shapes. To the 0·691 area B D we apply the root-five area B G, equal to C D. B K is a square, and K L two 0·6180 areas; and H F is composed of two 0·6180 areas; and J K is a square greater in area than the squares B K or C E. To the other end of the rectangle A B we "apply" the squares A M and N O, equal to the squares C E and B K. We now have by simple geometrical construction defined an area similar to the ground plan of the Parthenon with four squares one on each corner. To obtain the numerical value of the line N L we multiply the known line A N—*i. e.*, 111·341 by 1·4472. The result is 161·1326+ English feet B L is 111·341 multiplied by 0·691 or 76·9366 English feet. Added, the two lines give us 238·0693, or the flank length of the ground plan. The square B J is 76·9366 by 76·9366. B C is equal to 76·9366, and C P 34·4044 or the difference between 76·9366 and 111·341.

We now have for the sides of the four squares at the four corners of the plan the numerical value of 34·4044 feet. We may now consider the centering of the columns, and at the same time define the error between Penrose's measurements and the plan.

Fourteen columns from a flank give us the following measurements from centre to centre: 13·983—14·052—14·124—14·110—14·079—14·093—14·058—14·094—14·066—14·089—14·113—14·068—14·124—14·084, a total of 197·137. Dividing this by 14, we have as a mean 14:081 feet.

The mean distance from the edge of the top step to the centre of the second column is 15·456± feet. Multiplying this by two and adding 10 feet, the width of the steps, including the Euthynteria, multiplied by 2, we have 40:912 feet. This, added to 197·137, equals 238·049. The ratio measurement was 238·069. The error is 000·012—*i. e.*, two one-hundredths of a foot. It will be noted that the error by construction is always within the error of workmanship as we find it in the building. The mean distance from centre to centre of the columns is 14·081 feet. Penrose gives the distance from the edge of the top step to the cella wall in one case as 15·330, and in another as 15·350. The step width is 5·0; this added to 15·350 is equal to 20·350. If we consider the distance from centre to centre of the columns as the end of a rectangle, and the distance from the cella wall to the extremity of the Euthynteria as the side, such an area will be composed of a square plus a root-five rectangle —*i. e.*, the column centering widths, extending all around the building and excluding the angle columns and their immediate neighbors, with the distance from cella wall to step base, produce a series of areas similar to the generating area of the ground plan and directly connected with it by proportion.

14·081 + 1·4472 equals	20·378
Penrose's figures	20·350
Error	00·028

The greatest variations in the ground plan occur at the angle columns and their relation to their neighboring columns. This was probably due to the difficulty of making adjustments for refinements. In no case, however, is it much greater than an inch, a degree of accuracy difficult for others than practical architects to realize. From the centre of the second column to the top step the mean distance is 15·456± step width 5·0, result 20·456; mean centre to centre distance 14·081, result 34·537.* Side of the root-five square on each corner, obtained from the generating scheme, 34·4044, error 0·1326. This approximate error probably was a factor in the increment of curvature in the stylobate. Asked once by the writer what he thought the increment of curvature or sagitta actually was, Penrose replied that it was difficult to say, though he had assumed it to be a definite amount in his book. He thought two to two and a half inches would be close enough.

We now must consider the subdividing of the corner squares to place the centering of the first and second columns in relation to the third columns. Sides of these squares pass through the centres of the third columns. Thus we have an arrangement of the subdivided area of a square as in Fig. 8.

A B is a square; A C, B C, two areas each composed of a square plus a root-five figure; E D, F C are squares. If A E be regarded as unity, then the areas F E or F D are composed of the square F C plus an area of a square and a root-five figure; that is to say, 1·691. The reciprocal of this ratio (it is one frequently found in other Greek designs) is 05·913. The area B E or A D is composed of the square E D plus the square and root-five areas A C or B C, the ratio being 1·4472 plus 1·0 or 2·4472. The reciprocal of this is 0·4087. The reciprocal ratios 0·5913 plus 0·4087 equal unity or the line F B.

To construct within a square a square plus a square and a root-five rectangle: add a square and a root-five rectangle to a square. The ratio then will be 1·691, see Fig. 9. A B is a square, B C a square, C E, plus the root-five rectangle J B. A D is a diagonal to the entire shape. A E is the area desired within the square A B. A F is a square within the area A E. A G is a similar shape to A E. G E is a square. The centering of the columns in relation to the step width is done by a diagonal to the 1·691 area within the square on the corner of the plan as in fig. 10.

A B is a corner square; A C a 1·691 area within it, and the diagonal A C of this shape cuts the line D E at G. This point G is the centre of the first column from the angle column F—*i. e.*, the area G C is similar to A C. The columns G and I are closer to the angle column F than they are to the columns H and J exactly as we find them in the plan. The width of the steps on the plan is fixed by constructing a root-five area within the 1·691 areas of the corners, Fig. 11. A B is a corner square; A D a 1·691 area; C D a root-five area within A D; A C is the width of the steps.

Of course, the entire details of such a building as the Parthenon cannot be discussed within the limits of an evening's talk, especially when the subject itself has to be introduced. We must neglect the cella and the elevations with their details. It may be said, however, that the symmetry all of these conforms strictly to that of the ground plan. Moreover, the area arrangement we find in the Parthenon was not new to Phidais or Ictinus. Close inspection of the symmetry of over a thousand examples of Greek design from the sixth century to the first century B. C. shows that the motif or theme found in the Parthenon appears many times in designs previously made.

It should also be remembered that analysis is not synthesis. It is often a perplexing matter to follow a cold trail, while the trail itself was easy and simple made. The evidence appears to indicate that these proportions of dynamic symmetry were the outcome of a method of surveying by area wherein a diagonal to two squares formed the base. The figures given above may be varied slightly and the errors reduced because it is not always clear what the exact measurements were. According to Penrose, the plan is not an exact rectangle—is any building plan exactly rectangular as it is carried out in the work? The stylobate on each front is 101·341 for one, and 101·361 for the other; the flank length on one side is 228·154 for one, and 228·141 for the other. If we take the double step width as 10·0, and use 111·361 for the end and 238·141 for the side of a rectangle, the ratio 2·1382 leaves an error of $\frac{3}{10}$ths of a foot. Many confusing points of this character can only be cleared by another inspection of the building as it stands.

It may be added that the following ratios connected with 1·4472 and 0·691 appear in facades and details: Width of front, 111·341. Height of facade by construction, 64·60±. The lesser divided into the greater produces the ratio 1·7236. The fraction 0·7236 is equal to 1·4472 divided by 2. Penrose gives the average width and height of the triglyphs as 2·766 and 3·840. The lesser into the greater gives the ratio 1·382 (error 0·018). The reciprocal of 1·382 is 0·7236, or again 0·691 multiplied by 2. If the metopes were originally planned as squares, then metope plus triglyph is a similar figure to the facades, or 1·7236. The height of the angle columns, minus increment of curvature, is 34·250, the width of the abacus 0·685±; the lesser into the greater gives root twenty-five or 5 squares. The area factor which supplies all the details of the column head is root-five.

Root 25 equals 5·000
Root 5 equals 2·236

2·764 difference.

The difference 2·764 divided by 4 equals 0·691; or by 2 equals 1·382. The five squares of the angle columns are obtained by simple construction from a root-five area of the plan, see Fig. 12. A B is a root-five rectangle; A C an "applied" square on the end. D E is a diagonal; it cuts a side of the square A C at F. D H is an area equal to the area of the square A C and is composed of five squares—*i. e.*, it is a root-twenty-five rectangle.

To those unfamiliar with the present method of analytical proof by arithmetic the process may seem complicated. It is, however, quite the reverse, as a little familiarity with the method will prove. Very early in his work the writer found that geometrical analysis was fallacious in every way; it invariably results in mere playing with lines and shapes. With it rigid proof is impossible. As the method by

*By construction we obtained 34·4044 for the side of this square. If we consider 20·350 plus 14·081, or 34·431 as the side of this square the error is reduced to 00·029.

arithmetic now stands we may determine with great accuracy the symmetry of any design whatever without making a drawing. Diagrams and drawings are used to help the student visualize the facts and have nothing whatever to do with the proof.

In the discussion on the foregoing paper. Sir Cecil H Smith, LL.D. (Director of the Art Division, Victoria and Albert Museum), said he welcomed very much indeed the views which Mr. Hambidge had put before the meeting. If only architects could be got to take them up, we should once again find them designing for the industrial arts. The reason why the industrial arts had declined in the immediate past was largely because of the absence of architectural art in the designs. The Hindoo history of architecture showed us that the average Hindoo architect, in the past at any rate, was always expected to be a master of at least one other art. He was responsible not only for the architecture and decoration, but also for the warming of the building. In Persia the architect was, as a general rule, a mason, and in India both mason and carpenter. Judging from the evidence he had gathered from Mr. Hambidge's work and also from the result of his own researches at the British Museum, it seemed to him that Mr. Hambidge by his theory of commensurability of areas had hit upon an extraordinarily interesting truth. He was not clear, however, whether Mr. Hambidge meant that the artist of ancient Greece who made the vase or the small bronze was acting on this dynamic law, or whether he did it more or less intuitively, because he was so accustomed to seeing everything designed from that point of view that he would hardly fail to do the same himself. It was hardly conceivable that a Greek potter, a man of the lower orders, should have been conversant with the Books of Euclid and capable of working out the exact lines, determining the rectangles, squares and reciprocals on which the Greek vase was produced. However that might be, Mr. Hambidge's theory deserved the fullest consideration by the artists of this country.

The president, Mr. John W. Simpson, expressed the appreciation of the meeting of Mr. Hambidge's patient and learned exposition of the principles wherein he believed himself to have found the solution of the mysterious perfection of Greek art. If all were not convinced, it was doubtless owing in some degree to imperfect mathematical perception, not to the lecturer's clear explanation. He, for one, was not prepared to challenge him in a mathematical debate. A distinguished critic had expressed surprise that the Royal Institute should devote an evening to these purely theoretic problems. The answer might be given by Symonds' apothegm, "Learning cannot come amiss to those who understand its use." At this late hour [11 o'clock] he would content himself by observing that the term "symmetry," which Mr. Hambidge used so freely, required some definition before they qualified it with such adjectives as "static" and "dynamic." Mathematical "proportion" was not artistic proportion: the first was absolute, the second spiritual; not axiomatic, but a matter of delicate personal perception, none the less definite that it could not be reduced to rule, varying to infinity according to situation. It was really a sixth sense no two figures, no two plants, no two buildings, were alike. But, the connection between accepted beauty of proportion and the human figure was, to his mind, undoubted.

Mr. Hambidge, (in reply), answering the point raised by Sir Cecil Smith, said that men who were restricted in their design output must, if they were sincere, act more or less according to a certain line, and it was not a question whether they were conscious of what they were doing if they produced their results and if their rudder was set in a certain direction. Musicians worked according to certain lines, and did astounding things. Some curious things in Greek pottery had been discovered which were unsuspected, and they were led to question the idea of critics that these potters were such ordinary men. For example, there was man named Tleson, who was the son of a potter, and the brother of a potter. Dr. Caskey, in Boston, had found a delectable kylix made by him; apparently he always signed his work. This man Tleson made kylikes all his life; he made black-figured pots. But there was one red-figured pot by him at Naples. He had noticed in the British Museum, in Catalogue 4, other examples by him. The three examples he had seen were corroborative of Dr. Caskey's example in Boston. They showed a man struggling between the static type of what seemed to be a fairly late date, and one where he had almost reached the point of change. The example in Boston showed a complete change. When at Cambridge the other day, he noticed, in the Fitzwilliam Museum, another Tleson kylix. He measured it, and found it was an exact duplicate of one in the British Museum, the only difference being a slight one due to a shrinkage in the clay. It was static, because it was designed in two squares, and men did not make two squares fortuitously. The one in the British Museum and the one in the Fitzwilliam Museum were exactly a square-and-a-half; every detail was explicitly in the terms of two squares or a square-and-a-half. The one in Boston showed the dynamic arrangement. In Tleson's work, they had almost perfect examples of a man first using a measuring scheme of the linear unit, changing to one of an incommensurable linear scheme, and one of a commensurable area scheme. He thought the architects in New York had done the best thing: They immediately subscribed for eight lectures, and every possible angle and point had been thrashed out. The only thing to do was to take these examples and go into them analytically, have them explained with the drawings made by disinterested people, with all the measurements accurate. If they did that, a revelation awaited them. The human-figure question of type measurement was opposed to everything understood in modern times. The great mistake was made by Vitruvius, a Roman, who said in his book on Architecture that the Greeks were carrying out certain principles of Greek symmetry that they derived from the human figure, and they were said to do this because members of the human frame were commensurable with the whole, and he assumed it was commensurable with the line. That had persisted to this day, with the effect of corrupting everything which had been written on the human figure for two thousand years. If we took the skeleton, or the live figure, and interpreted the area, we had something which was entirely unknown before.

Housing and Planning Problems of Greater Paris.

By NILS HAMMARSTRAND.

THE recent land acquisitions for the purpose of establishing garden suburbs may indicate that a turning point in the development of Paris has been reached, inasmuch as these acquisitions at least give promise of a new land policy. *These acquisitions have been made by the newly founded Office Departemental d'habitations a bon marche, which is an organ of the Department of the Seine, not a municipal agency. Under the legal and administrative conditions now prevailing it has been impossible for the municipality of Paris to take an effective initiative in the matter. This circumstance may serve to recall the fact that among the most important questions of improvement regarding Paris there is also the very essential problem of a departmental and municipal reorganization, which question cannot be left aside in dealing with the city planning problems of Paris. In the previous article referred to above some allusion to its importance has been made. "The housing conditions," it was said, "are even worse in the suburbs than in the city proper, which circumstance confirms the fact that the rational development of the suburban areas has been neglected in the very highest degree. The powers of the city in the matter of planning have not reached any farther than to its jurisdictional limits; the authorities of the Department of the Seine have failed to take the necessary initiative, and the suburban communities have either not been able or not willing to handle their own development in a satisfactory way."

Therefore it is increasingly being recognized that a radical administrative reform will have to be made for the purpose of establishing a closer co-operation between the various municipalities of the Department, making out of the whole departmental region a unified sphere, undivided in regard to the common interests. At present, even in the most important matters affecting the whole urban agglomeration, city and suburbs, there is no real interrelation between the 79 communities which make up the Department of the Seine. Each of them has its own communal representation, independently handling all matters, big and small, whether or not they affect the whole community unit. Intercommunal questions should, it seems, be dealt with by a joint body, representative of all the interested communities, and the frame of such a body exists at present in the Counseil general de la Seine, consisting of representatives for the 22 departmental cantons, outside of Paris, and for the 80 quartiers, in which the city is divided. "The Conseil general," says M. Henri Sellier in a pamphlet recently published*, "would evidently be qualified to handle those public matters which the city of Paris and the suburban communities would refer to the Department. Some modifications of the present legislation would be sufficient for attaining this result." What M. Sellier proposes, in this publication, is in reality a radical administrative reorganization aiming at creating a municipal structure very much resembling that of Greater London, as it became established in 1888.*

It ought to be mentioned that M. Sellier's proposal is not entirely new, this form of organization having been suggested previously by various students of the administrative problems of Paris. It should also be noticed that M. Sellier takes into consideration other forms of organization, suggesting themselves in this case, such as the form of intercommunal syndicate of which the greater Berlin "Zweckverband" is an instance, or the form of an absolutely unified, strongly centralized community, established through incorporation of all the suburban communities. For various reasons, which the limitation of space prevents us from exposing, Mr. Sellier rejects both these alternatives arriving at the conclusive estimate that the administrative organization of the London type is "the most rational" for the great urban agglomerations.

M. Sellier also deals at length with the numerous inconveniences and shortcomings attendant upon the present conditions of administration, characterized by him as "the administrative anarchy in the Department of the Seine." It is, however, not only, or even chiefly, the existing form of administration that is responsible for the present, in many respects very unfavorable status of the urban agglomeration, seen as a whole. It should be remembered that Paris and its suburbs have been for centuries what they still are, a collectivity very little deserving to be so called. Foremost among and common to the various parts of this singular, antiquated collectivity are those burdens and unsatisfactory conditions which steadily have grown heavier and become more aggravated in consequence of longstanding, exceptionally unfavorable conditions of development. True enough, there are beside Paris other great urban centers where suburban development, during certain periods, has been considered detrimental to the interests of the city and where, accordingly, a policy of counteracting suburban growth has been pursued. But probable nowhere else has such a policy been so systematically and so tenaciously upheld, and this in regard to a city which already in the sixteenth and seventeenth centuries was expansive in a very high degree, actually being a large city at the death of Louis XIV, when it numbered in all probability more than 400,000 inhabitants.

As applied to this city the limitation policy, as it may be called, must unavoidably entail disastrous consequences, through increasing the overcrowding under which Paris suffered badly in the seventeenth century, the congestion being promoted also by other causes than the limitation policy. Of the overcrowding in Paris at the time of Louis XIV testimony appears in contemporary literature. Notable foreigners, as Sir J. Lister and Sir J. Evelyn, have testified to the conditions, and we are justified in believing

*See "The Housing Problem in Paris," The Journal of the American Institute of Architects, February, 1920.

*Henri Sellier: Les banlieues urbaines et la reorganisation administrative du Departement de la Seine. Paris 1920.

*Since 1888, when the London County Council was invested with power to handle all matters of general interest concerning the whole county, the city has expanded considerably, so that now almost half of Greater London is outside the county boundaries. Thus the County Council no longer answers the needs of Greater London, and the administrative problem of London will have to be dealt with anew.

that they constituted an "unparalleled case" at the time. Jacques Gomboust, author of a plan of Paris, published in 1652, says in his description of the city that "it has a quantity of five- and six-storied houses, all of them full to the tiles of diverse families and professions" and that "its houses are so high that it seems as if there were two or three cities, one upon another, and so full of people that there is no empty room; all the streets are so to speak paved with people who push each other as in processions." Montesquieu, in his "Lettres Persanes," makes, more than a half century later, similar statements, and an Italian, Marana, author of "Lettre d'un Sicilien," published in 1692, illustrates in a picturesque way the attendant effects in regard to land values and rents; "a small room," he says, "is worth more than ten houses in Moscou."

At the end of the reign of Louis XIV Paris seems still to have been the largest city in Europe. Probably toward the middle of the eighteenth century London began to surpass Paris as regards population, and it was at that date, in all probability, also greater than Paris in regard to size. In London the family dwellings were more frequent, the apartment houses less numerous than in Paris; under housing conditions, which on the whole must have been considerably better than those of Paris, London was characterized by a more horizontal development, contrasting with the more vertical of Paris and of other large or middle-sized cities of the European continent. Here the influence of fortification girdles, of lack of communications and of arbitrary endeavors to hamper suburban development made themselves felt, producing congestion in urban centers and rapid increase of their land values, which also, in the long run, unfavorably reacted on the value of the more outlying grounds. The social habit of living in apartment houses thus became established and the attendant economic effects were of such a nature that they constituted a strong guarantee for its perpetuation, even if they did not actually impose it as an economic necessity, as it has been variously maintained We may rather consider that existing tendencies presently became deliberately exploited in imposing a detrimental system of city development, secured and applied with the aid of administrative methods. When the fortification girdles had fallen and the great expansion of cities began as a consequence of the developmeet of modern industry and communications, the voluntary and yet very automatic covering of miles and miles of extension grounds with apartment barracks commenced. At this time the broad and expensive street was introduced everywhere, whether actually needed or not, and rapidly became a predominant constituent of the continental city planning practice. Much land which could have been used to advantage was thus wasted, and the great costs of construction and upkeep of the new "avenues" and "boulevards" being charged to the abutters, these costs contributed toward again raising land values, by increasing the over-exploitation of the building plots and by swelling the bill of the tenants. Multiplication and elaboration of hygienic and technical requirements, applied to apartment houses, were thought to bring the salvation of cities; city planning became a purely technical maker, planning and construction of streets, and it thus failed of its social mission, to help in securing satisfactory conditions of housing.

In this general development—nearly general, at least, on the European Continent—Paris has played a prominent part. The transformation and the extension of Paris under Napoleon III have certainly been very instrumental in giving an impetus to development, an assertion which by no means, however, is tantamount to a wholesale condemnation of this great city planning work. In analyzing this matter, we have to make a distinction between the re-planning of the old parts of the city and the extension planning, which constituted a considerable part of the work. The replanning was urgently needed, was carried through in a bold, unprecedented fashion and, on the whole, in a way answering the needs. The cutting through of board traffic arteries was necessary, and as it generally proceeded across very expensive land, which became still more expensive through the operations, we could not expect to find the new thoroughfares lined by detached family dwellings. Criticism of this part of the great work will mainly have to be directed against details and also against the general method of execution, which too consistently, it seems, preferred the opening up of entirely new streets, adaptation to the existing conformation by widening of old streets being avoided.

The results of the extension planning are, on the other hand, more open to criticism. It constituted a continuation and partly a modification of the extension planning on no small scale which had taken place during the first half of the nineteenth century. During the July monarchy, and earlier, vast tracts, partly inside, partly outside the city boundary—approximately the line of the present "exterior boulevards"—had been planned and exploited for building purposes, and toward 1850 the very broad exterior boulevards were, in fact, to a great extent lined by suburban buildings. Ten years later, in 1859, the incorporation of the whole area between the old city limit and the fortification girdle being decided, considerable planning in this area was undertaken, as also in contiguous areas inside the old city limit. In regard to this work the charge has been made against those who carried it out, that it was altogether too much conceived in that spirit which a distinguished German writer on city planning, Professor Rudolph Eberstadt, has deprecatingly characterized as the "cult of the street." This extension planning did in reality to a great extent indulge in the creation of expensive streets of a stately width, whether they were actually needed or not. It is possible, even probable, that their practical necessity was undoubted at the time, but even if such were the case, the ensuing results are condemnable. Between replanning and extension planning no real distinction was made; the new, broad arteries of the interior city, opened up in the interest of sanitation and traffic, were reproduced and multiplied in the exterior areas, which were planned and plotted in such a manner that the predominance of the apartment house, as a building form, was assured. Thus, while transformations and extension planning gave a strong impetus to the rise of land values and to stimulating land speculation, there was also laid a foundation for those unsatisfactory housing conditions which are extensively prevalent in modern Paris, no building ordinances or sanitary regulations, however, elaborate, having been able to improve them effectively.

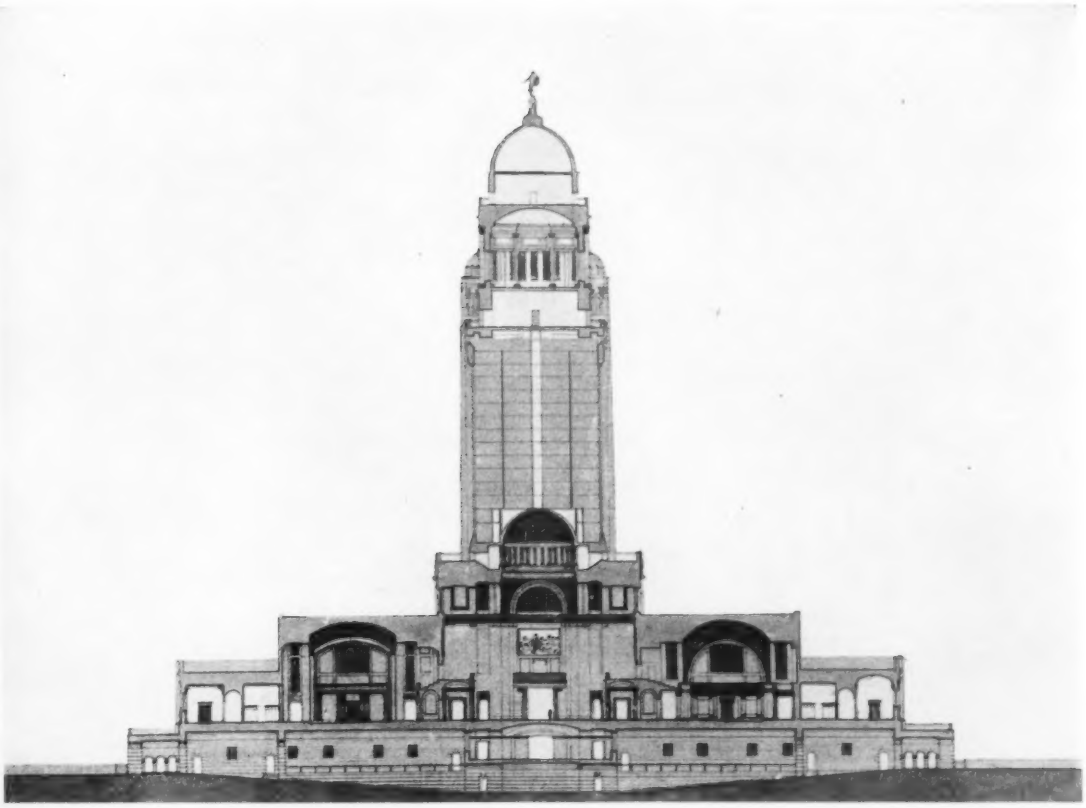
It has been very much in imitation of this development—and with the same consequences—that the extension has

proceeded in other expansive European cities, where the apartment house already had gained a foothold sufficiently strong to make its victory easy. However, as applied to Berlin or Stockholm, Vienna or Budapest, this extension system is still more to be criticized. For the situation in Paris was unique, inasmuch as it remained a city within fortifications after the extension of the city boundaries, the municipal custom duties also being maintained; both these circumstances concurring in separating city and suburbs and even in putting them in opposition to one another, the status of Paris and its suburbs thus remained what it had been for centuries. At the time it was, however, eagerly proposed to abolish the municipal custom duties and to extend the city to the limits of the Department of the Seine. Even if this had been carried through, the ensuing development might have been very much the same; but it is evident that the existence of the fortification girdle and the maintenance of the custom duties, so to speak, guaranteed a city planning policy characterized by the effort as one of its chief aims in housing to house as many individuals as possible within the city limits.

To illustrate the various characteristics and consequences of this development statistical figures could easily be given referring to the area of the streets as compared with the area of land ocupied by buildings, to the open spaces within the building plots as compared with the built-on area, to the average number of inhabitants per acre of covered land, and to the increase of the land values. Chiefly interesting at the present moment, however, are the figures regarding the increase of land values which constitutes the main difficulty and the very essence of the housing problem that Paris now is facing. But no figures of recent date are available, and a quotation would consequently give only a very inadequate idea of the present situation, which is determined not only by the fact that land values generally are unusually high even in the outer suburban areas, but also by the lack of foresight as regards the communal land policy. It is evident that in Paris—as everywhere else where similar conditions have been prevailing—the failure on the part of the community to pursue a rational land policy is partly responsible for the present situation in regard to land values, this situation at the same time making the initiation of such a policy extremely difficult. The community of Paris would certainly be justified in congratulating itself, if it now possessed at least part of that land, of no small extent, which it has had in posssession, but has alienated. And its troubles would be greatly diminished, if it had been in a position to acquire before the war, even at high cost, vast and suitable lands in the outlying suburban areas. That this has not been the case is illustrative of the city planning situation not only in Paris, but in France generally anterior to the war, at a time when in several other European countries numerous communities made extensive land acquisitions for city planning purposes, being encouraged in these undertakings by the authorities of the state. In this connection one can not help making comparison, and they are distinctly not in favor of France. The same observation may be made with regard to the unearned increment, which remains untaxed. For the period 1902–1911 the unearned increment in Paris alone has been estimated at nearly 550,000,000 francs, all of which went into the pockets of the property owners, none of it accruing to the community.

The situation, as exposed above, offers an especially interesting illustration through the public activity for improving housing conditions which developed in Paris before the war. Construction of low-rent houses was undertaken on a rather large scale, either by the community itself, or with communal support, by private building associations formed to this end, but the buildings erected were exclusively six or seven-storied apartment houses. The prevailing land values imposed this house type, and if we admit it to be the least suitable for those classes of the population which low rent houses generally are meant to harbor, we arrive at the conclusion that the housing problem of Paris is eminently one to be solved in the outlying suburban areas, whether in or outside the Department of the Seine. As told in a previous article the public"Office Departemental d'habitations a bon marche" has in recent years acquired land in these areas, aggregating nearly 500 acres, with a view to developing them into garden suburbs. Thus a small beginning has been made in regard to a reform which, to become effective, will require action on the very largest scale. State intervention is to be expected and has actually been called for by the municipal and departmental offices for low-cost houses, which last year joined in addressing an appeal to the State authorities demanding their financial support in carrying through housing reform. Subventions to the amount of two billion francs, in the form of credits on easy terms, were demanded. At the same time certain modifications of the present legislation regarding low-cost houses were proposed.

However, manifold are the hindrances which obstruct the housing reform, ranging from hostile political interests, unusually strong in France, to high land values, high cost of labor and materials. Expropriation of extension land and of building materials is being resorted to in Germany at present, and the question is whether or not France will have to do the same. As regards Paris especially the state of the communications is also to be mentioned as one of the main obstacles in the way of housing improvement. The betterment of the public means of transportation, their multiplication and extension to all parts of the outlying areas constitute of course a problem, on the solution of which success will largely depend. It seems evident that this can be attained only by an intercommunal action of great scope, and that the new railway lines should be planned and measures taken for their realization in immediate connection with the acquisition of vast outlying land for communal building purposes. It is certainly not by merely completing the subway system inside the fortifications that one will succeed in solving the traffic problem of a city which counts more than three million people inside its limits and more than a million outside in the immediate vicinity. "Paris n'est pas une ville, c'est un monde," goes an old sentence, but if Paris wants to secure its future existence, it will have to reveal its status of "world city" also in its methods of action.



Nebraska Capitol Competition

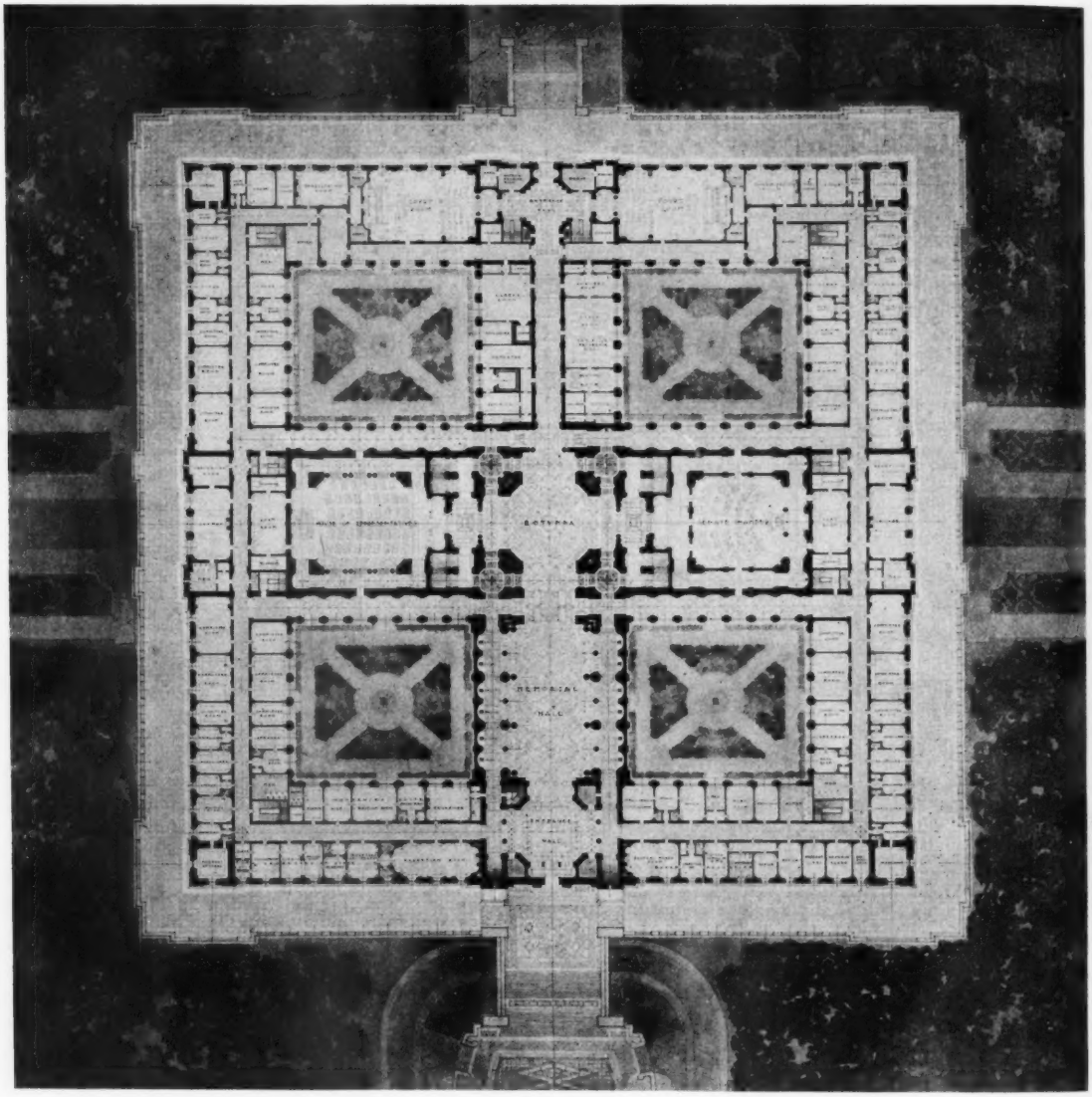
MR. GOODHUE'S THESIS

THE site is a square in the heart of the city of Lincoln, the point of intersection of two great avenues, while the surrounding country is generally level. Therefore, from the very beginning, the authors of the design herewith submitted have felt impelled to produce something quite unlike the usual— and, to them, rather trite—thing of the sort, with its veneered order and invariable Roman dome.

As their studies have progressed, this impression has but deepened, finally taking form in a vast, though rather low structure, from the midst of which rises a great central tower, which, with its gleaming dome of golden tiles, would stand a landmark for many miles around. Though everywhere monumental, no element of the practical or convenient has been sacrificed to this end. Even the tower is no mere useless ornament, for its shaft contains the glass-floored, many storied Library book-stack.

It has seemed to the authors that the traditions of ancient Greece and Rome and of Eighteenth Century France are in no wise applicable in designing a building destined to be the seat of Government of a great western commonwealth: So, while the architectural style employed may, roughly, be called "Classic", it makes no pretence of belonging to any period of the past. Its authors have striven to present something worthy of the high uses to which the building is to be devoted, an index to that which is within, a State Capitol of the Here and Now, and naught else.

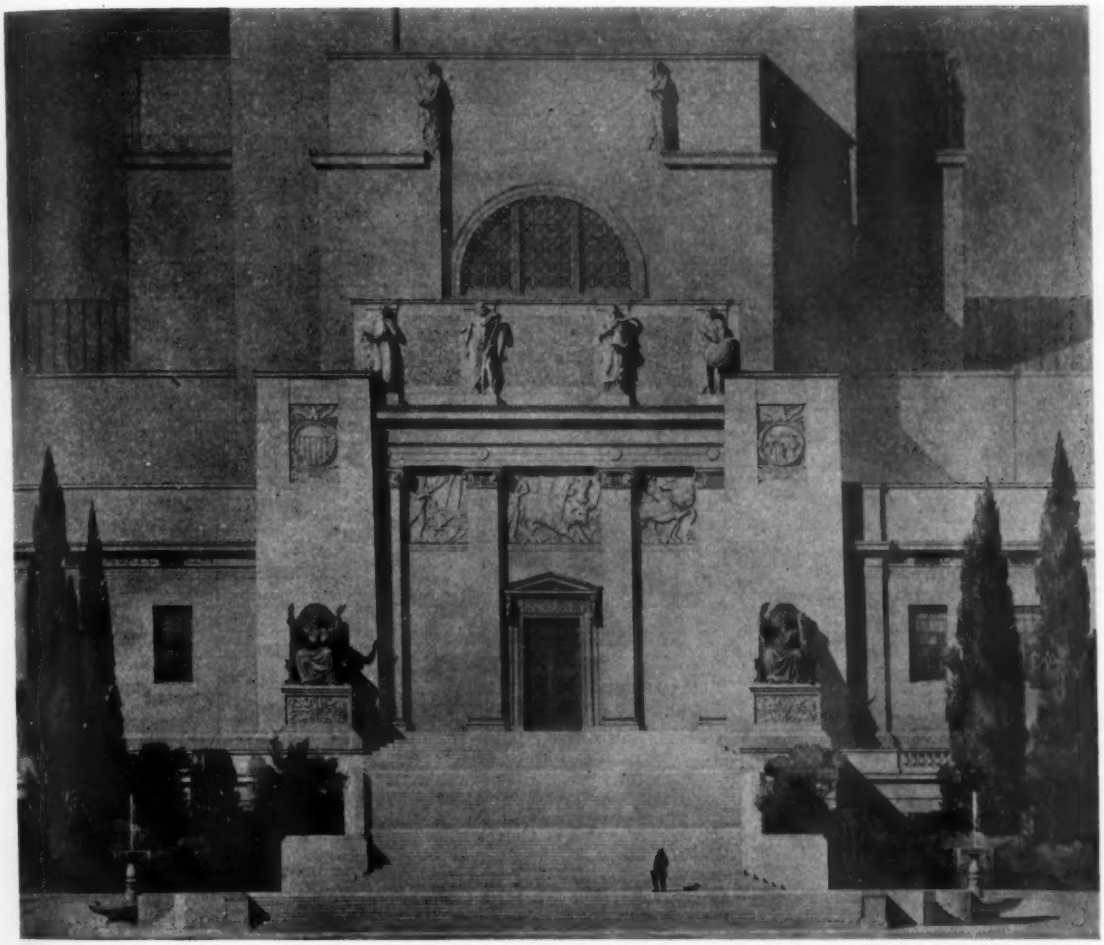
Aside from the Rotunda, Memorial Hall, and all specified requirements, and quite exclusive of all corridors, toilets, and staircases, the design provides eighty-five thousand square feet of directly-lighted floor space. Of this about ten thousand feet are given over to the Restaurants, Kitchen, Engine Room, and the like, leaving seventy-five thousand feet of unassigned space, which might readily be greatly increased were the restaurants and kitchen placed in the upper—and uncounted—portion of the tower, a suggestion less radical and more feasible than appears at first sight. In addition to the space required for the present Library, the tower book-stack provides forty-four thousand linear feet—sufficient, that is, to take care of the present rate of increase for one



hundred and ten years to come—meanwhile giving space for other unspecified purposes.

Throughout the building's interior arrangements, the authors have striven to achieve the greatest degree of directness, compactness and economy consistent with convenience and dignity. If actually built, they are convinced it would prove no labyrinth to the unfamiliar visitor, and that this none-too-common—though surely desirable—end has been attained not only without sacrificing, but by actually increasing its monumental quality. Because of climatic conditions, the plan has been grouped around four large courts, which, cool in summer, would yet be protected from the cold winds of winter. Also for the same reason, the outer windows have been kept small, with those larger than open on the courts.

It is incontrovertible that a single building housing all departments is more economical and more compact than a number of detached units having the same aggregate floor area; therefore, this design is essentially that of a finished entity, as such scarcely susceptible of extension in the form of wings certain to encroach seriously upon the pleasant tree-shaded space, which the authors regard as quite vitally part-and-parcel of the whole. If in coming years, additions prove desirable, these should take form as quite separate, though harmonious, structures, set about the square and lining the main avenue of approach, which in the block plan is shown widened



and parked, and where, facing the Capitol's entrance, they have set French's noble figure of the "Great Emancipator." The authors have ventured, too, to carry Fifteenth Street directly beneath the building thus providing protected and thoroughly convenient carriage entrances.

Cubic Contents

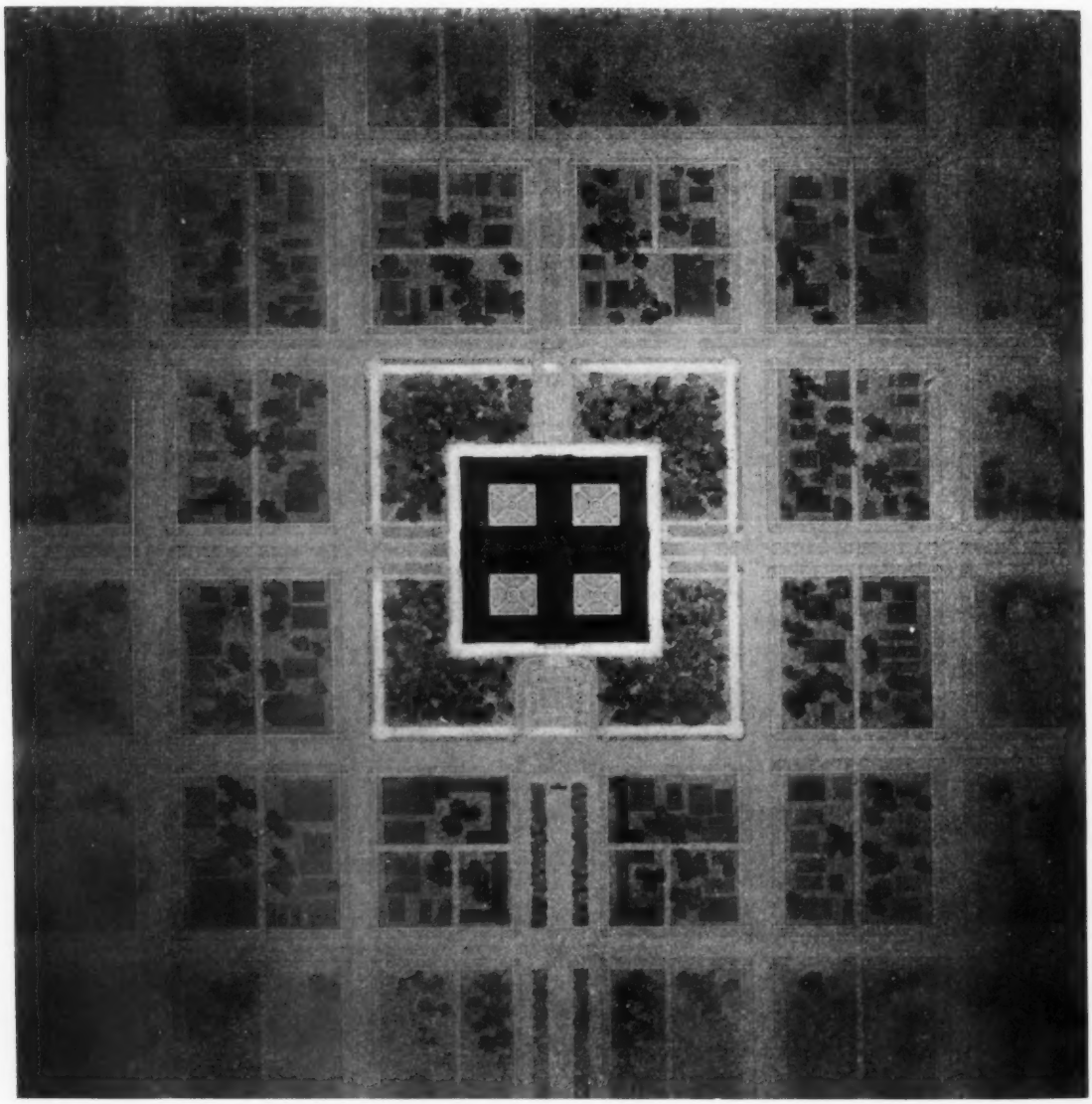
Basement projecting under terrace	595,556 cu. ft.
Basement and first floor of four low wings inside terrace line	2,912,230 cu. ft.
House of Representatives	552,030 cu. ft.
Senate Chamber	552,030 cu. ft.
Additional cubage through driveway underneath	100,800 cu. ft.
Memorial Hall	409,500 cu. ft.
Corresponding wing to Memorial Hall	434,700 cu. ft.
Four projections of tower	331,296 cu. ft.
Tower from basement	1,582,257 cu. ft.
Total	7,470,409 cu. ft.

Report of the Jury for the Nebraska State Capitol Commission

Believing that the best way to secure a design for a great and monumental building is to select directly a competent architect and then by collaboration, through a series of studies, develop with him a scheme covering essential requirements, your jury in this spirit, after analyzing for more than three days the various schemes submitted, reached the following conclusion:

Heretofore, in National, State, County and Municipal building projects, the practice of selecting an architect by competition has proven in so many instances to be impractical and unsatisfactory; impractical because of currents in politics, personal preferences and "misguided loyalty;" unsatisfactory because such a process has eliminated that requisite collaboration between the architect and owner before formulating the scheme of the building.

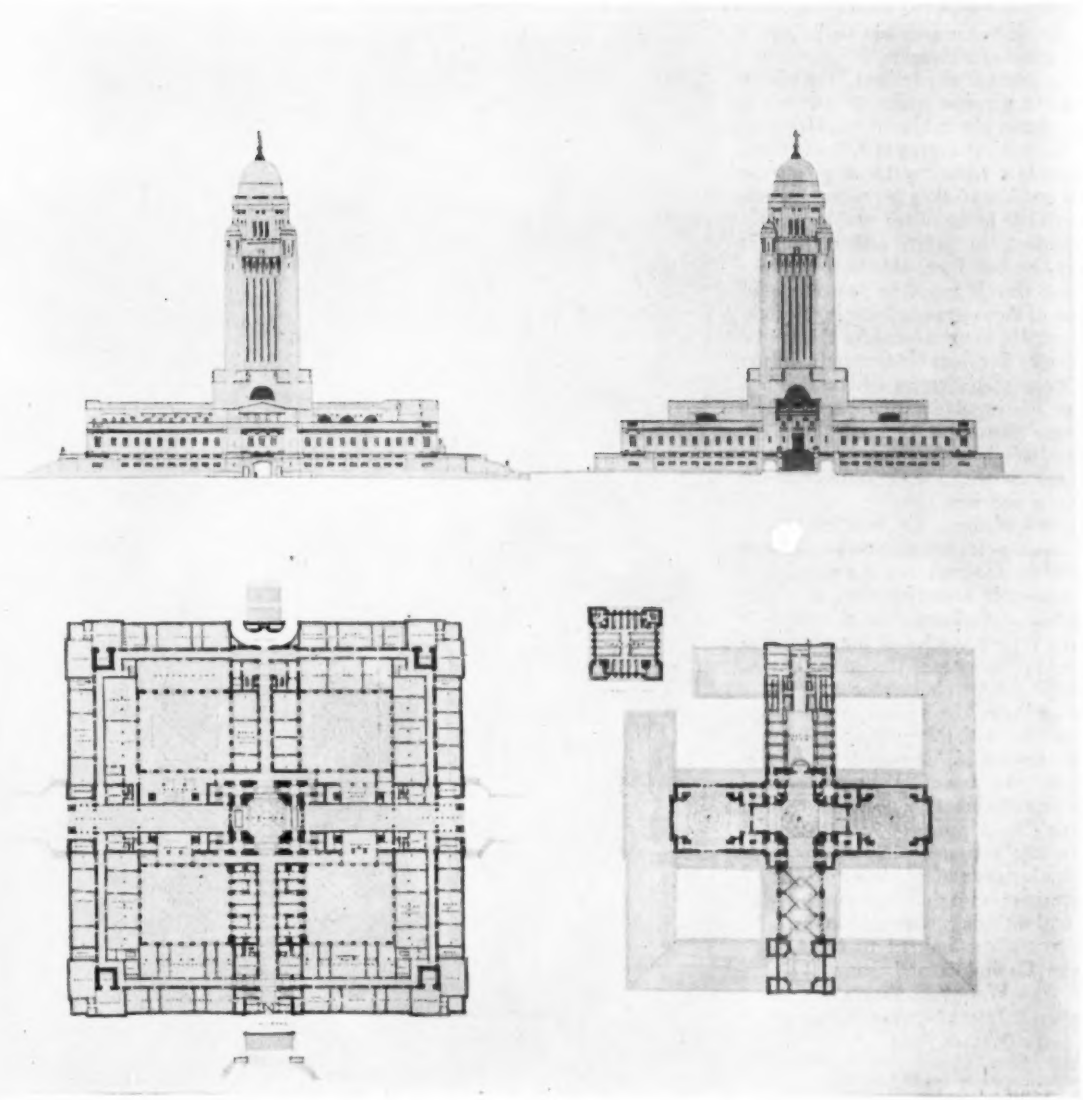
Your Jury in this belief desires, first of all, to commend the Capitol Commission and its Professional Adviser for having in the program governing this competition promul-



gated a document that it expects will prove to be of great value, not only to the State of Nebraska, but to the Nation at large. This competition under this program has demonstrated that there has been found a means of approximating the advantages of direct selection of an architect in a situation where competition seems to be necessary. Your jury not only wishes to commend this program for its liberal scope, but desires to point out that its task has been greater than it would have been under the old method of selecting a design of a building rather than a designer of a building.

The problem of selecting an architect by means of such a program involves expressions more subtle, more psychological and much more difficult than the mere study of the drawings for the selection of a design from which to build. In other words, the solution was not the simple one of selecting, by means of the easier method of comparison of definite designs, but the more complex one of selecting, by means of the showing made in this competition, the architect who would be best equipped to design, on requirements not yet matured, a building that would represent collaboration between owner and architect. While your program fortunately contained no large restrictions or petty mandatories, it demanded a most serious study of the broad questions of architecture.

The program gave us a definite basis on which we were to form our judgment, namely—"utility," "appearance," and "expenditure," each to be given equal weight, but in considering these three attributes we cannot ignore the atmosphere of breadth, vision and freedom of the whole



program; the appreciation that the Capitol is the outward sign of the character of the people of Nebraska,—the Highway of Progress, the Provider of Man's necessities, the Battle Ground of Freedom, the Distributor of Learning, the Home of the Volunteer.

A monument to the "Highway of Progress" should be guided but not fettered by the legacies of the masters; the "Provider of Man's Necessities" calls for the noble and inspiring; The "Battle Ground of Freedom" knows not ignoble servitude; the "Distributor of Learning" has its foundation on knowledge; in the "Home of the Volunteer there must be courage.

After devoting three days of study to these ten sets of drawings, your Jury believes that they demonstrate that a high-water mark has been reached in the presentation of such schemes and designs, for all of the competitors, except two, have presented designs of the highest merit.

In the study to arrive at its verdict, your Jury by a process of elimination first reduced the number of contestants to six, then to four, then to three. It may be of interest to your Commission to know that at this stage of study the three designs selected as best answering the problem presented three types, not because the Jury felt that we should finally consider diffierent kinds of buildings, but because the three different kinds of buildings considered happened to best embody the solution of the program. Then after eliminating one of these three designs, the Jury decided that between those remaining the author of the

design marked with the identifying number 4 should be the architect to design the new Capitol of Nebraska.

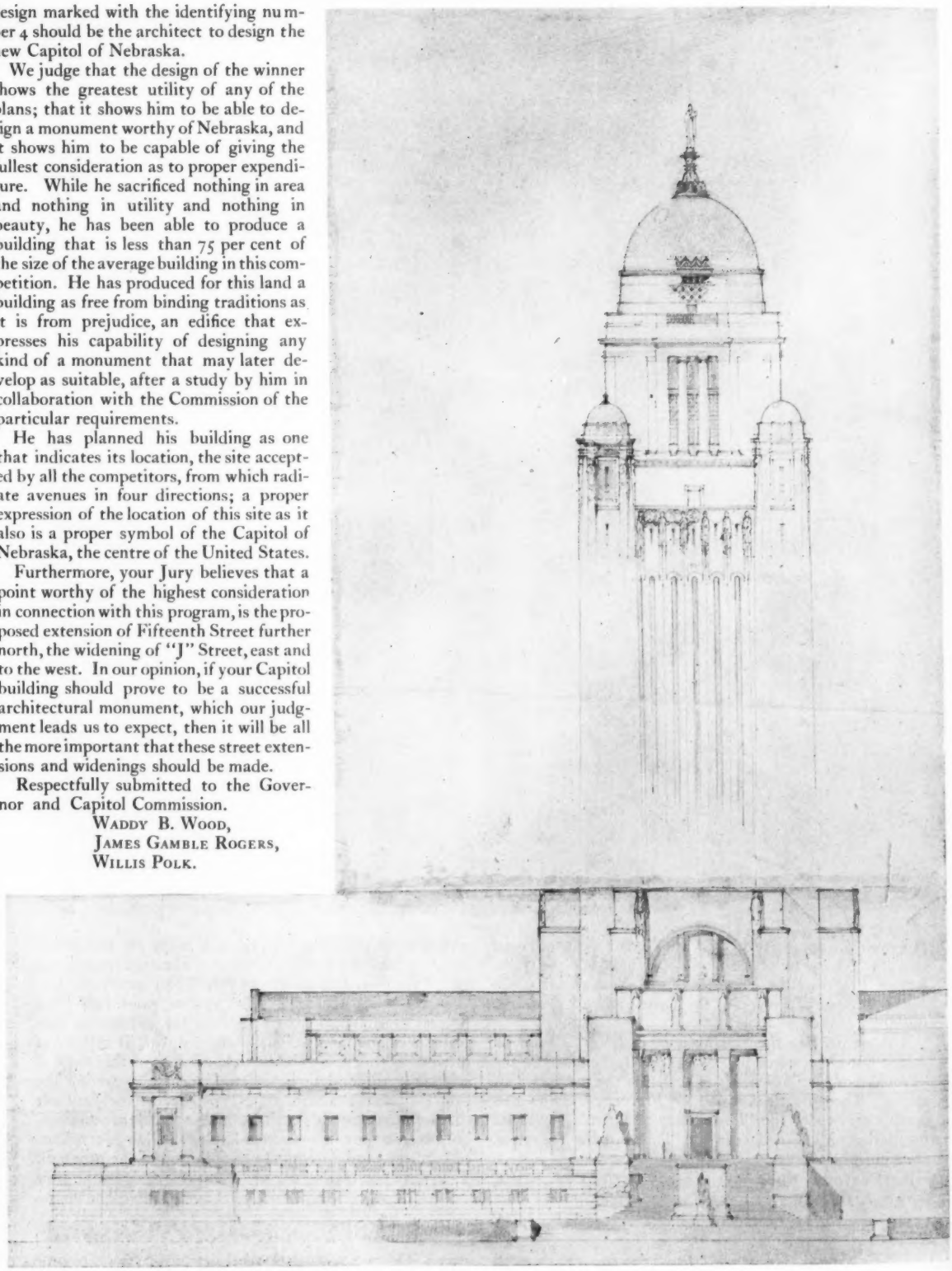
We judge that the design of the winner shows the greatest utility of any of the plans; that it shows him to be able to design a monument worthy of Nebraska, and it shows him to be capable of giving the fullest consideration as to proper expenditure. While he sacrificed nothing in area and nothing in utility and nothing in beauty, he has been able to produce a building that is less than 75 per cent of the size of the average building in this competition. He has produced for this land a building as free from binding traditions as it is from prejudice, an edifice that expresses his capability of designing any kind of a monument that may later develop as suitable, after a study by him in collaboration with the Commission of the particular requirements.

He has planned his building as one that indicates its location, the site accepted by all the competitors, from which radiate avenues in four directions; a proper expression of the location of this site as it also is a proper symbol of the Capitol of Nebraska, the centre of the United States.

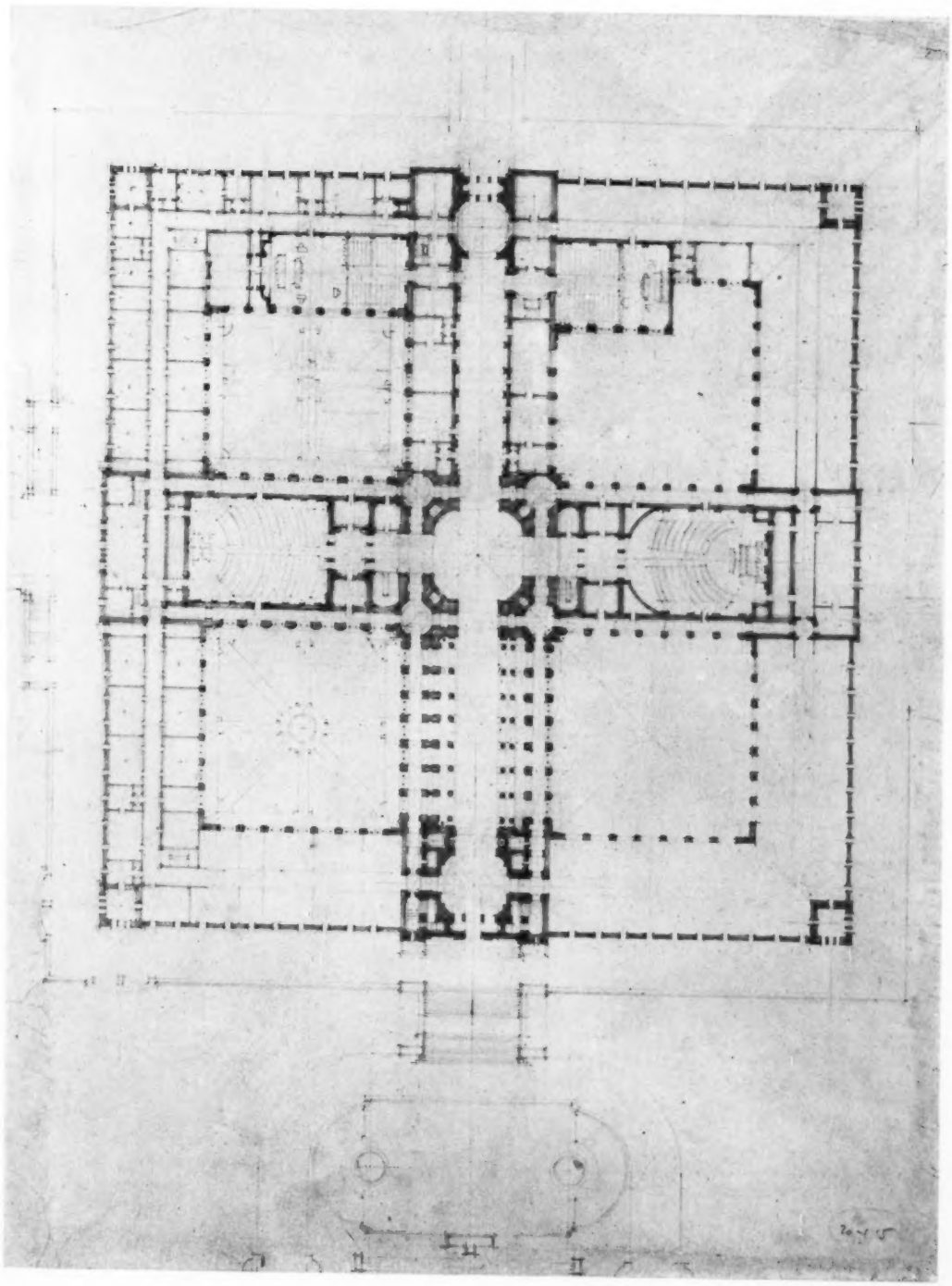
Furthermore, your Jury believes that a point worthy of the highest consideration in connection with this program, is the proposed extension of Fifteenth Street further north, the widening of "J" Street, east and to the west. In our opinion, if your Capitol building should prove to be a successful architectural monument, which our judgment leads us to expect, then it will be all the more important that these street extensions and widenings should be made.

Respectfully submitted to the Governor and Capitol Commission.

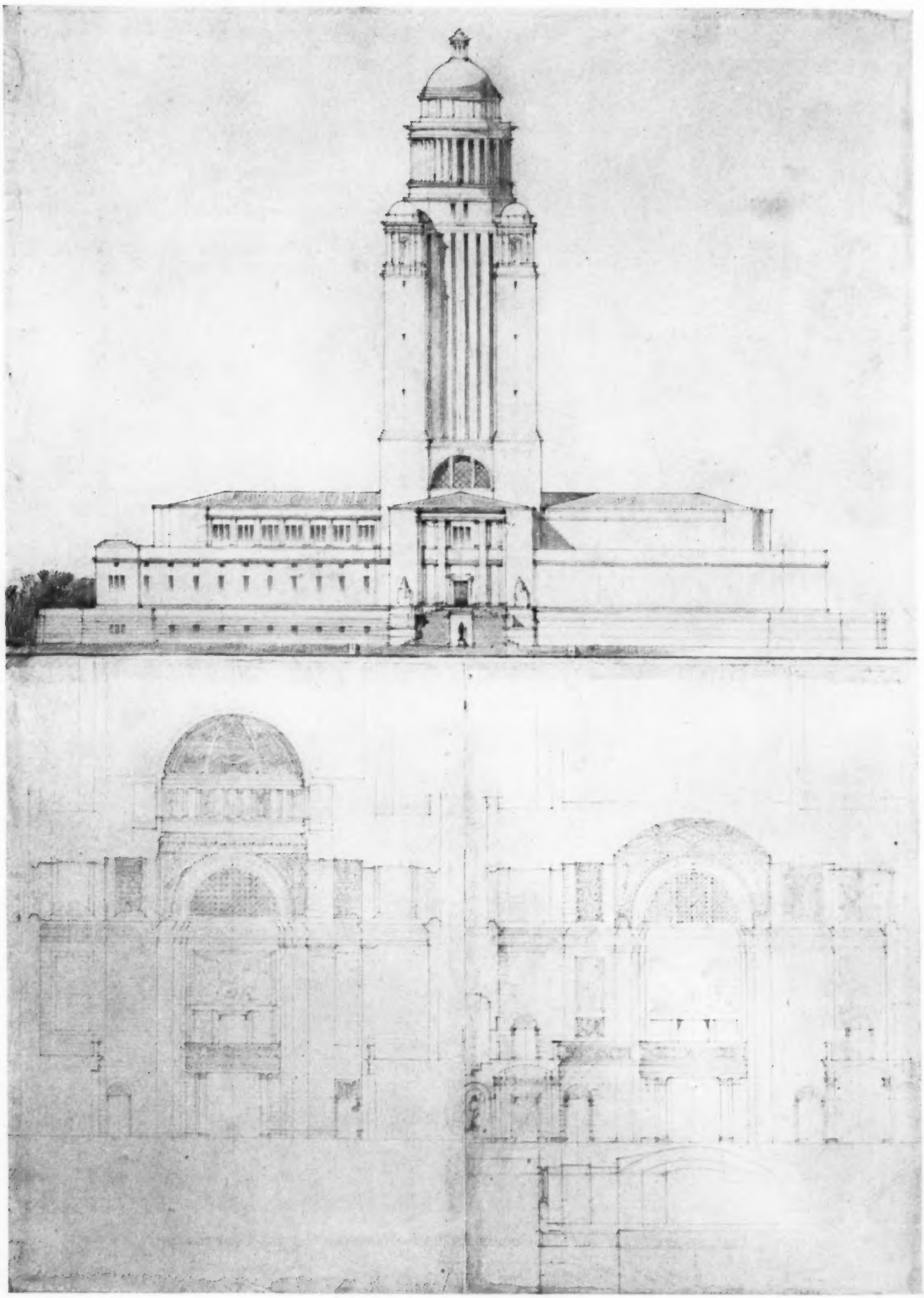
WADDY B. WOOD,
JAMES GAMBLE ROGERS,
WILLIS POLK.



FINAL STUDY OF MR. GOODHUE'S MAIN ELEVATION AT REQUIRED SCALE—NEBRASKA CAPITOL COMPETITION



PRELIMINARY STUDY FOR MR. GOODHUE'S PLAN—NEBRASKA CAPITOL COMPETITION



Top—Early Study for Mr. Goodhue's Main Elevation—Nebraska Capitol Competition
Left—Final Study for Rotunda Right—Preliminary Study for Rotunda

The Building Industry in the United States

In connection with the Senatorial investigation of the housing situation in the United States, the following letter has been addressed to the Hon. William M. Calder, United States Senator, Chairman of the Senate Special Committee on Reconstruction and Production:

The Philadelphia Chapter of the American Institute of Architects desires to participate in the inquiry now being conducted by the Senate Special Committee on Reconstruction and Production. After having conferred with the representatives of the construction associations in the meeting in Philadelphia on June 17, it feels that its viewpoint on the question at issue can best be set forth in a separate analysis of the situation.

Basic Conditions.

The condition of the Building Industry can be satisfactorily described by statisticians as it falls within the realm of ascertainable facts. But while we are interested in observing that its volume is subnormal and its characteristics are abnormal, we are chiefly concerned in seeking the reasons for these phenomena, for the disease can be attacked intelligently only after it has been correctly diagnosed. We, therefore, regard with indifference any proposals for or against a policy of freight priorities, or legislation intended to influence the migration of the laboring classes, convinced that the effect of these or similar measures can only be temporary and cannot materially alter the general situation.

The industrial revolution was brought about by the substitution of machine for hand process in production. It dates from the latter end of the eighteenth century. Notwithstanding that the change in industrial technique has resulted in a broadening of the scope of human information the knowledge thus amplified has not been relatively deepened. In spite of the advancement in certain material comforts that the transformation has brought in its train, the sinister fact stares us in the face that for scores of millions of human beings, high speed production made possible by the use of machinery has been distorted by man's cupidity from a potential blessing into an actual curse.

The modern slum, a legitimate offspring of the central factory system, is little if any improvement over the worst housing conditions of the middle ages.

Business Interest is the Prime Force

The Construction Industry has, in the main, no control over its own product for the reason that it is the servant and tool of other and more determinative forces. The business interest of the prospective owner dictates the choice of site and the character of the building, the direction of the railway and the location of its terminals. It is, therefore, pure waste of time to concern ourselves with the misuse and disuse of the implement while taking no thought of the hand that guides it. The desire or the necessity to make a business profit, treating the accompanying social and economic problems as of comparatively small importance, lies at the root of our difficulties and determines to a large extent our actions.

Construction Interest the Servant of Capital

The Construction Industry is involved in the present discussion only because it is unable to quote a price satisfactory to the investor. It is out of a job. The only thing asked of it is to cheapen its product and this is manifestly impossible so long as it is organized on a system of wasteful, rather than stimulating, competition, while at the same time its employer continues to hold and exercise the power of increasing the cost of materials that enter into the finished product. Construction is necessary to house and transport the output of labor and cannot be considered apart from the business it shelters.

Present Conditions and Reform

The two things to be studied are, therefore, first, the direction given to modern life by the theory of business profit and second, a reorganization of the Construction Industry by which it may better serve its own personnel and the public at large.

Lack of Capital

A fundamental cause of the diminishing volume of construction is of course the fact that capital can only be obtained for a profit-making enterprise. Capital cannot be reasonably asked to sacrifice itself upon the altar of altruism, but nevertheless when profit alone is considered, only the highest bidder can obtain credit and sound enterprises are forced to compete with ventures of a highly speculative nature for the favor of money lenders.

The directors of savings banks, even when their customers are mainly of the poorer classes, administer the funds solely in the interest of their stock-holders and themselves and no public condemnation attaches itself to the policy. The fact that the depositors may be sorely in need of houses cannot receive consideration with the directorate unless a speculative builder may prove that he will, within a stated time, repay the capital sum advanced together with interest and premium on the loan. He naturally competes with other builders in search of credit and when he succeeds it is at the cost of the house he sells. He degrades and diminishes his product until he wins the smile of capital. Thus in an overwhelming sense modern commercial philosophy accepts as axiomatic that service be subordinated to business profit.

The Manufacture of Wasteful Goods

To a major extent the manufacturing industry is organized for the making of goods for a financial gain without a thought of the service or dis-service they may render to society. The sale of wasteful goods frequently yields a large money return and, working under a system where the making of a profit rules other motives, the tendency is not only to concentrate on this class of output but to invent and put upon the market new forms. While the practice is not universal it is nevertheless true that so large a pro-

portion of our productivity is devoted to waste that the stability of the social structure is being measurably impaired. While the welfare of the community is not totally ignored it is treated as of secondary importance to the prosperity of the individual.

This philosophy is generally accepted throughout the business world. It is the reason why the quality of durability of goods is of no advantage to the manufacturer and in many cases is a distinct disadvantage.

Modern Business Method

Now the placing upon the market of an avowedly useless article or an article in which the characteristic of waste is predominant, and the deliberate creation by advertising of a public demand for it, is a typical example of modern business method. A thoughtless public has been told that it is the operation of "making something out of nothing," that it is the "creation of wealth," while the very contrary is true. As a matter of fact it is a completely futile employment of human effort. Its producers are economic burdens upon the community in the same sense and degree as are the inmates of a county poor house.

The Result

This tendency, harmless enough when pursued to a limited extent, has grown to a point where, in conjunction with other causes, it has made impossible the carrying on of necessary building. While the friction has always existed the great damage attributable to it has, for several reasons, escaped general attention. It is unobtrusive and all-pervading. It does not work in fits and starts, and, therefore, society has been able to adjust itself to the handicap. Its very ubiquity has contributed to its concealment. But the war has unsparingly exhibited the weaknesses of an acquisitive society and what has been regarded as a normal tendency has suddenly become an intolerable oppression.

No Negative Legislation

The concentration of a great portion of our energy upon luxury production and upon the production of short-lived wealth is the logical resultant of the industrial order. Accepting the system, at least for the present, we cannot legislate against its workings. Hence, to attack it with prohibitions is to invite failure. Indeed, for other practical reasons it would be dangerous in the extreme to forbid the production of any given article even though all the evidence proclaimed it to be a useless luxury; for such a policy would but too likely sound the death knell of scientific research and artistic expression, the two things which more than any others have contributed to the development of the human race. Nevertheless, a way must be found to provide building for necessary but relatively unprofitable uses.

Capital Helpless

If the sole aim of the Construction Industry is to seek employment for itself, then it is probably true that, given a sufficient amount of capital, such an aim could be attained. But there is no chance that in the immediate or distant future credit, privately controlled, will serve other than the highest bidder, leaving the situation much as it is at present.

The Action to Take

This rapid and incomplete sketch of our social and economic system reveals how small is the chance that anything of moment can be accomplished by a reliance upon the time-honored formulae. But the situation, although grave, has a fortunate aspect for it furnishes the opportunity to the Construction Industry to arise to the occasion.

Let it commence by proclaiming itself an instrument of public service, insofar as its duty to the community will be considered before profit.

Let it refuse to operate in the sole interest of its private employers.

Let it insist that the execution of necessary building, properly related to a general scheme, shall take precedence over less urgent needs.

Let it concern itself with the social and economic welfare of its own personnel as a means to true efficiency.

What will such a program lead to in terms of action?

Necessities of Life

It is unquestionably true that an industrial system, or even any particular industry, which fails to make possible adequate shelter, food, clothing and recreation for all of its operatives is not worthy to exist. Its basic charter must include the obligation so to distribute and so to place its earnings that the employee will be afforded a fair opportunity to purchase the necessities of life.

The Lack of Houses

With housing standing in the first group of civilization's demands, the terrible indictment lies against the industrial system that throughout the entire world it is impossible to build a home for those earning low wages or salaries at a cost which will allow it to be rented or sold without a loss. In order to house decently the present population of the United States from ten to twenty billions of dollars will have to be expended. Private initiative for this purpose has entirely broken down and the home, one of the main reasons for the existence of industry in any form is, and has been for many years practically unattainable for a constantly increasing portion of the human race. By what right do we spend our time in debating the case for industry or the buildings which shelter it when the only motives for its establishment are in default?

A Housing Program

The manufacture for profit of the skilled wage earner's home, never sufficient in quantity or quality, has now ceased.

The manufacture for profit of the unskilled wage earner's home has, largely speaking, never existed.

In view of these facts, we, the architects, propose that housing for those earning low wages or salaries be legalized as a public utility; that the manufacture of this class of homes as a profitable industry should cease in theory as it has already ceased in fact and that the government, national and local, should at once adopt measures making possible the supply of this prime necessary of life.

The Economic Program

Eventually Industry must be so organized that the opportunity will be afforded to all those engaged in it

to earn their living in the full sense of the word, but under the present circumstances we believe that we have indicated the one possible course of action. This program does not avoid the loss. Only in special cases will it be met by private interests and then only when it can be collected from the profits of production. The capital will have to be supplied from the public purse and the loss will be met by the difference between the interest charged and the market rate or by an undisguised subsidy or by both. There is no escape from this dilemma other than by a complete change in the present capitalistic society and that, of course, is not here advocated. The principle of remunerated service as opposed to speculative profit must be the corner-stone of the edifice. Even state aid will break down if the value which it creates is constantly dissipated. It is not pretended that we are offering any detailed scheme of operation. We are now contending for a principle and at the proper time we stand ready to assist in its realization. We submit that whenever our system of business for profit fails to provide any of the basic necessities of life then the task, ipso facto, should devolve upon the public authority; that while the principle is now accepted for public education, water supply, and like functions, it must be extended to housing. A refusal to meet the obligation will spell disaster to society as it is now organized.

Such a building program, vigorously pursued, would occupy the energies of the Construction Industry for years to come and would mean the creation of durable wealth at a rate not hitherto attained in our country.

Loss of Wealth

Construction is wealth and like all wealth is consumable in a degree. Its disappearance due to obsolescence, unsuitability, disintegration, fire, neglect or any other cause is, therefore, loss to the community. In proportion as the production of wealth is sacrificed to the making of a profit, the durability of that wealth decreases. When consumed it has to be re-created. It is a duplication of effort. The problem is to determine what part of this annual loss is preventable and then to take measures to overcome it. What part of our building program is considered from the viewpoint of an addition to the national wealth and what part is frankly designed for the sole purpose of making a profit? The true answer to these questions will show that the element of service has been obscured by the desire to reap a personal reward to a point where the drag upon our national resources fills us with apprehension.

The Necessity of the Planning of Cities

But it is not enough that houses shall be merely built. It must not be forgotten that in erecting homes, factories and shops, we are creating towns and cities and to proceed on the old selfishly thoughtless or thoughtfully selfish lines will only increase urban congestion and in the end, magnify rather than diminish our troubles. In the execution of any such scheme as we propose, we must strive to see clear through to the end, in order to lighten, if possible, some part of humanity's unnecessary burden.

The slightest reflection will lead to the conviction that a more thoughtful placing of buildings will diminish the waste-factors of obsolescence and unsuitability. Indeed, the advantage of scientifically planning our building development once admitted, our group is prepared to submit documentary evidence that the losses due to the planless accretion of our cities and transportation facilities represent an annual loss of hundreds of millions of dollars. This loss bears with crushing weight upon the Construction Industry for no enterprise can be healthy when so much of its effort is uneconomic.

The Planning of Cities and Lines of Communication

An answer to our special problem cannot be found without examining the physical structure of our cities and their connecting transportation lines of every character, for these things are construction itself and it is only by planning them definitely and scientifically and building them honestly, that there is any hope of diminishing the present alarming waste of human effort and capital.

A Survey

The placing of buildings and the layout of our transportation lines is a matter of growth, planless in the sense of any correlation on the part of the entirety, but rigidly controlled by the underlying philosophy of modern business enterprise, the making of a profit. Now this policy has generally been accepted as sound, as a conservative and prudent development of "natural tendencies," but it has lead directly to the most uneconomic, the most wasteful scheme of life ever devised.

To increase in size is the major ambition of our cities and is an aspiration to which all others are subsidiary. With few exceptions city plans are based upon the conception of unlimited inflation and permission to study methods by which urban life may be made more tolerable is only granted upon the well understood condition that nothing is to be done looking towards the elimination of the selfsame causes that have made urban life so hard to support. No wonder that city planning is largely futile.

The theory is founded upon a negation, the desire to do nothing which will decrease the value of urban land. The theory is positive in that it guards jealously the supposed right of the individual to reap a speculative profit on land. It operates to increase concentration at the center and diffusion at the perimeter, both tendencies pursued to a point where, after a certain size is reached, the city becomes an economic impossibility. And here is where we now are. Due to these and other causes it has grown to a degree of immensity which makes impossible the financing of its public utilities. The universal predicament of street railways is an illustration. But in their special case there are difficulties which complicate the financial problem, for by reason of the great distances to be covered and the enormous number of passengers to be transported, they can be operated only at the cost of infinite discomfort to the public.

Distribution of Values

The conception of the modern city is based upon fundamentally wrong economics and contains the seeds of its own destruction. Any system of economics which takes and does not return, any system of agriculture which, having produced the crops, takes no measures to restore the fertility of the soil, any system of physics or philosophy which allows the appropriation of energy generated by

effort and takes no measures to cancel the debt is destined to exhaustion just as surely as is a constantly worked coal mine. The values created by the community belong to it and when diverted to individual use, result in public bankruptcy. In violation of this law of nature the increment, loosely and deceptively qualified by the word "unearned," is partitioned amongst the few and the powerful to the despair and impoverishment of mankind. To expect the Construction Industry to be possessed of a healthful life in such an atmosphere is unreasonable. It is suffering from the very situation which it is employed to create.

There can be no way out until the principle of public service receives recognition as a practical working force—until business for private profit is brought within reasonable bounds—until our cities are restored to an economic form and size, a quite possible thing to accomplish—until our lines of communication and their terminals are planned for the service to be rendered, and not only for a money return.

If the objective seems to be beyond our reach it is principally because we have never made any serious, concerted effort to attain it.

JOHN IRWIN BRIGHT.

By the authority of the Executive Committee of the Philadelphia Chapter of the American Institute of Architects.

EDITOR'S NOTE: While it is true that many great nations have practically declared housing a public utility and have arranged to provide the necessary supply through subsidies granted from the national treasury, and that the United States finds itself at present in a situation where no other remedy seems available, if substantial housing accommodations are to be provided, it is also true that from the standpoint of all industry this method of procedure is in effect an acknowledgement that industry itself is incapable of paying its workers a sufficient wage or salary to permit them to buy or rent houses of the standard now admitted to be their right. Thus any subsidy granted for housing is in reality a subsidy granted to industry, and this is utterly inadmissible except as a temporary truce in the present economic impasse. It is for this reason that there seems to be no ultimate escape from either the present situation or the new ones created by the palliatives employed except through a complete reconstruction of the whole industrial process, and although the above statements do not advocate such a change they clearly envisage it as a step that must some day be taken, if the premises of the report are sound.

It is inconceivable that society is ready to commit itself to a principle which is in reality its own self confession of utter economic failure. When industry cannot earn a profit to its owners and also provide its workers with the necessities which are the only justification for its existence, the State is confronted with a problem that is grave indeed. Shall it subsidize a broken-down industrial machine in order that it may continue to earn profits even though it cannot produce and provide the necessities of life, or shall it compel the industrial machine to rebuild itself on lines which will oblige it to function as an instrument of public service to the State? The latter conclusion was the verdict of the Committee on Scientific Management and Reduction of Cost, of the Building Trades Parliament of England. No other way out has yet been even vaguely suggested.

In support of the particular point of view as to housing, in the foregoing, there is appended the following resolution as adopted at the Inter-Allied Housing and Town Planning Congress held at London in June last and composed of delegates from all the Allied Nations:

"That in the opinion of this Congress, legislative action in the preparation of a National Housing Policy should be taken by each Government (with wherever necessary special financial provisions relaitve thereto), such programme to be carried into effect on lines of co-operation between the Government on the one hand and Local Authorities on the other.

"Further, this Congress is of opinion that such a Housing policy should be sufficient in its scope and character to secure that within the limit of twenty years every family shall be housed under proper conditions with adequate provision for amenity in regard to surroundings."

The Congress also recorded its conviction as to the establishment of certain minimum standards in housing and likewise passed the following very sweeping resolution:

"That this Congress is convinced of the importance of exercising wise governmental control and guidance in regard to town planning both regional and local.

"Further, this Congress desires to place on record its recognition of the importance of the following principles:

(1) That in order to secure adequate provision of air and light in and around the homes of the people there should be definite limitation of the number of dwellings per hectare, and for space adjacent to dwellings, such limitation being a matter of Governmental determination in each country.

(2) "That the policy of decentralisation of industries and the building of new garden cities should be encouraged by legislative provisions and by all other means, both public and private.

(3) "That each Government, acting in partnership with local authorities, should prepare in advance and carry into effect a regional survey, followed by planning schemes, with a view to putting an end to wasteful and chaotic developments and securing that the lines of future growth shall be well ordered and scientific.

(4) That in view of the acknowledged necessity of such action the Government should, acting in co-operation with local authorities, control the direction and assist in the upkeep of main and arterial roads.

News Notes

UNDER the heading "Education" in the report of the Convention published in the June number, the following resolution, as affecting the length of courses in architectural schools, was reported as having been laid on the table: "Resolved, That the Amercian Institute of Architects does hereby recommend to all schools to lengthen their courses in architecture to a period to exceed four years in order to make it possible to include such necessary studies as heve been left out of the curriculum, and to give more time for the more complete assimilation of the subjects taught."

The resolution was laid on the table, but the following substitute resolution, inadvertently omitted from the Journal because of the haste in going to press was passed as follows:

"*Resolved*, That inasmuch as thoroughness in all courses taught is of the first importance, the American Institute of Architects recommends that if a school can give a course in architecture of only four years to students who have had no other preparation than that required for admission to college, such a course should cover the fundamentals thoroughly, leaving advanced work to a fifth or graduate year; but that for such students a five year course is to be preferred."

A UNIFORM schedule of hours for draughtsmen, as prepared by the Committee on Contracts and Specifications was approved by the Southern California Chapter at its June meeting. The number of working hours per week is

fixed at 44, working eight hours a day except on Saturday, when the period is reduced to four. Six holidays without loss of pay are fixed, and time and a half for overtime. Two weeks vacation with pay to men regularly employed for a year. The schedule applies to draughtsmen only and not to head draughtsmen, chief engineers, clerks of works, superintendents, or heads of departments.

REPRESENTATIVE architects and engineers of Minnesota met at Duluth on June 29 last and laid the basis for a Federation of the Architectural and Engineering Societies of the State. Delegates from the Minnesota Chapter of the Institute participated in the Conference, which appointed committees to proceed with the work of permanent organization, report to be made at a second conference called for November first. It is not the purpose of the new Federation to supplant or interfere with any of the existing professional bodies but to weld them together for concerted action upon matters affecting the welfare of the state and of the profession as well. Membership in the Federation will be through membership in some local organization only. It should also be noted that a joint committee of three Architects and three engineers has been appointed to draft a registration bill for presentation to the next legislature, and that the two professions should support the bill.

AT A SPECIAL MEETING of the Southern California Chapter held on June 19, the proposed affiliation of the Chapter with the California Engineering Council was approved and the constitution of the Council was referred to a special committee for later report to the Chapter. Like the Minnesota Federation referred to above, the California Council will be representative of the various technical societies in the state, the expense of maintenance being borne by contributions from those societies in proportion to their membership.

A RESOLUTION protesting the action of the Convention in the matter of Jurisdictional Awards was adopted at the June meeting of the Southern California Chapter, as follows:

WHEREAS: The resolution of the Southern California Chapter to the American Institute of Architects, protesting against the plan of the National Board of Jurisdictional Awards in the Building Industry, which protest was sent to the Executive Committee and officers of the Institute, and presented with accompanying resolution by the delegates of our Chapter at the Fifty-Third Annual Convention at Washington, and was there refused recognition by the Convention, and

WHEREAS: This protest was made with due respect to the American Institute of Architects and its officers and directors, but was necessary because the matter protested by the Chapter, was contrary to public policy in the territory of the Chapter, therefore,

BE IT RESOLVED: That the report of the delegates with respect to the matter of protest be referred to a committee for further study and recommendation as to the best methods of making this protest effective, and protecting the inalienable rights of the members of the Southern California Chapter in matters of public policy, and that the President be authorized to appoint a committee of at least seven members, to report their recommendations of action to the Chapter.

THE SCARBOROUGH Conference of the British Labor Party voted to ask for the resignation of Dr. Addison, the Minister of Health in charge of the housing program of the British Government. It also voted for state loans to encourage building, state control of building material, higher hygienic standards in housing, and the encouragement of direct labor (that is, the adoption of either the Guild Plan or the elimination of the contractor by having the authorities take over the control of the whole operation.

One of the interesting factors developed was the carefully calculated statement by a delegate from Glasgow, showing that whereas the interest charge on the capital required to build a typical workman's house before the war was eight pounds, it is now sixty.

PRESIDENT KIMBALL has appointed a special committee to cooperate with the Commission of Fine Arts—on invitation of Chairman Moore. The personnel of the Institute Committee is as follows: Mr. E. W. Donn, Jr., Chairman, Mr. Percy Adams, and Mr. Louis A. Simon.

Obituary.

John A. Fox

Elected to the Institute in 1875; to Fellowship in 1889.
Died at Dorchester, Mass, May 4, 1920.

Major Fox was born in Newburyport, Mass., on December 23, 1835. His parents removed to Boston and he attended the public schools of Dorchester, graduating with the first class from the Dorchester High School. After leaving school, he entered the employ of Garbett & Wood, civil engineers.

Major Fox was in business for fifty years. He made the first survey of Stony Brook and the marsh land which is now the Back Bay District. During his career as an architect, he supervised the erection of some of the most historic buildings in and around Boston.

He was a charter member of the Boston Society of Architects, a member of the Military Order of the Loyal Legion and the Pickwick Club of Dorchester.

Willard T. Sears

Elected to the Institute in 1870; to Fellowship in 1889.
Died at Boston, Mass., May 21, 1920.

Mr. Sears was born in New Bedford, Mass., November 5, 1837, and early evinced a love for architecture. Plans were made for him to enter Harvard, but a serious accident, occurring in his seventeenth year, prevented this. To shorten the hours of convalescence and after his recovery, he studied architecture in the office of Mr. Eaton, an architect of New Bedford, and later went in to the office of Mr. J. F. Bryant of Boston. When twenty-one years old, he leased an office for himself. Later, in the early sixties, he was associated with Mr. Charles A. Cummings, a connection which continued for about thirty years.

In later life Mr. Sears practiced his profession under his own name. He erected the Gardner Palace, Mt. Auburn Chapel, several hotels, and was chosen by the Committee to furnish the design for the Provincetown Monument. An especially interesting achievement was the rebuilding of the Hayti Cathedral, which had been previously destroyed several times by earthquakes.

Mr. Sears was a founder of the Boston Society of Architects, a charter member of the Boston Art Museum, and President of the Cape Cod Association.

Structural Service Department

SULLIVAN W. JONES, *Associate Editor*
LEROY E. KERN, *Assistant*

In connection with professional societies, organized bodies, and the following Committees of the Institute, working toward improvements in building materials and methods, and higher ideals in the sheltering of humanity:
BASIC BUILDING CODE, CONTRACTS, FIRE-PREVENTION, STRUCTURAL SERVICE

Convention of the A. S. T. M.

Professor Thomas Nolan who officially represented the Institute at the Annual Convention of the American Society for Testing Materials, held at North Asbury Park, N. J., June 22-25 last has submitted a report which deserves special mention.

Professor Nolan states that of the sixty reports presented at the Convention twenty-one are of special interest to the architectural profession. These twenty-one reports are the following:

Report of Committee A-1, on Steel.
Report of Committee A-2, On Wrought Iron.
Report of Committee A-5, on Corrosion of Iron and Steel.
Report of Committee C-1, on Cement.
The American Institute of Architects is a member of this Committee.
Report of Committee C-2, on Reinforced Concrete.
Report of Committee C-3, on Brick.
Report of Committee C-4, on Clay and Cement Sewer Pipe.
Report of Committee C-6, on Drain Tile.
Report of Committee C-7, on Lime.
Report of Committee C-8, on Refractories.
Report on Refractory Brick.
Report of Committee C-9, on Concrete and Concrete Aggregates.
Report on Modulus of Elasticity of Concrete.
Hydrated Lime as affecting the Strength and Wear of Concrete.
The Effect of Rodding Concrete.
Report of Committee C-11, on Gypsum.
Report of Committee D-1, on Preservative Coatings for Structural Materials.
Report on an Instrument for Measuring the Hiding Power of Paints.
Report of Committee D-4, on Road Materials.
Report of Committee D-7, on Timber.
Report on the Properties and Uses of Water-resistant Plywood.

It is reported that the American Engineering Standards Committee has accepted as a tentative American standard for Portland cement the specifications and tests recommended by Committee C-1, and adopted by the A. S.T.M.

Professor Nolan also reports the organization of a joint committee on specifications for concrete and reinforced concrete consisting of five representatives from each of the following five societies:—American Society of Civil Engineers, American Concrete Institute, Portland Cement Association, American Railway Engineering Association, American Society for Testing Materials. The object of this joint Committee is to prepare standard specifications for reinforced concrete. Professor Nolan comments:—"The Institute, and all architects and engineers will understand the importance and value of standard specifications for this building material, the use of which has now reached such enormous proportions."

Current Reviews.

Porosity and Volume Changes of Clay Fire Brick at Furnace Temperatures.—The Bureau of Standards has recently published Technologic Paper, No. 159, "Porosity and Volume Changes of Clay Fire Brick at Furnace Temperatures," by George A. Loomis, Assistant Ceramic Chemist, Bureau of Standards. The testing and classification of fire brick has been a subject of considerable attention in recent years. Refractoriness is generally conceded to be a primary requisite of fire brick for general use. Fire brick may however be called upon also to resist abrasion, the penetration of slag, to resist sudden changes in temperature and deformation under excessive or very light loads at high temperatures.

This paper gives a general description of the various methods employed for testing fire brick and a detailed description of the method of conducting the porosity test. As a result of this series of tests the following conclusions are published:

1. Bricks which are capable of withstanding a pressure of 40 pounds per square inch at 1350 degrees Centigrade generally show slight changes in volume or porosity when burnt at temperatures up to 1425 degrees Centigrade.

2. The greater number of the bricks which failed to pass the load test show rather marked change in volume or in porosity at some temperatures below 1425 degrees C.

3. Bricks which show distinct overburning by pronounced expansion at temperatures below 1400 degrees C., invariably fail in the load test. The adoption of a definite limit for the permissible expansion within the given temperature range is particularly important for detecting inferior clay refractories. The limit of expansion should be lower than that for the allowable contraction.

4. The changes in volume and in porosity of bricks burnt at some temperature between 1350 degrees C and 1425 degrees C serves, in a measure, as a criterion of their ability to pass the load test.

5. Most of the bricks which show a porosity decrease not exceeding 5 per cent and a volume change not exceeding 3 per cent (approximately 1 per cent of linear dimensions), when burnt at 1400 degrees C, will pass the load test.

6. Bricks which show a decrease in porosity exceeding 5 per cent, or an expansion or contraction in excess of 3 per cent by volume (1 per cent in length) at 1400 degrees C, in nearly all cases failed to pass the load test.

7. The use of limiting porosity and volume changes for clay fire bricks at 1400 degrees C would serve as a means of eliminating from consideration a large number of bricks which fail to pass the load test.

8. Bricks which fail in the load test due to failure in the bond may not show marked changes in volume or porosity in burning, but often show very low cold crushing strength.

9. No definite relationship seems to exist between the softening point of a fire brick and its ability to withstand load at high temperatures. However, all bricks which softened below cone 26, whether siliceous or not in character, failed completely in the load test. It seems advisable, then, to specify cone 28 as the minimum softening point for any clay fire brick. It is probable that bricks containing less than 65 per cent SiO_2 should have a minimum softening point of cone 31.

10. Bricks with an initial porosity below 21.5 per cent and with an average decrease of about six points in percentage of porosity contracted about 5.5 per cent in the load test. Bricks showing an average porosity above 21.5 per cent showed a like contraction in the load test with a change of about three points in porosity percentage.

Portland Cement.—The Bureau of Standards, in Technical News Bulletin, No. 37, has issued a pamphlet on Comparative Tests of Normally and Finely Ground Cement. The data obtained from tests on a normally ground and a finely ground cement of the same brand have been computed and a report issued. These two cements were tested in 1:1–½:2, 1:2:4, and 1:3:6 concretes of two consistencies, as well as in a neat mix, and in a 1:3 standard sand mortar. The results of and conclusions from these tests were:

1. The strengths of concrete made of the fine cement were regularly and consistently greater than those made with the normal cement so far as the tests have been completed.

2. The percentage increases in strength on the fine cement concretes over the normal cement concretes for different periods were:

	2 days.	*7 days.*	*28 days.*	*3 mo.*	*6 mo.*
Minimum...	90	50	30	21	14
Average....	121	66	56	41	42

It should be noted that the difference in fineness between the two cements was 12% and to obtain the per cent increases in strength for each per cent increase in fineness, the figures in the above table showing the increase should be divided by 12. The normally ground cement had 86% passing the 200-mesh sieve as compared with 98% for the finely ground material.

3. The percentage increases were greatest at the earliest ages and in the leanest mixes.

4. The strength increases in lb. per sq. in. of fine over normal cement concrete were greater in the mixes containing the greater proportions of cement.

5. If the two cements had been used on a job, the following approximate mix proportions could have been used to give the same strength at 28 days, if consistencies and aggregates were the same:

Using Normal Cement.	*Using Fine Cement.*	*Approximate saving in bags of cement per cubic yard.*
1:3–½	1:5	2.1
1:4–½	1:6	1.5
1:6	1:8	1.2

(Proportions were one part of cement to sum of volumes of sand and gravel measures separately).

6. When used in 1:3 mortar, the fine cement produced a more marked percentage increase than when used in the concretes. The percentage increases in the neat mixture however, were the same as in the concretes. Thus, in the cases of cements tested, the results of the work on neat cements gave a better indication of their values in concrete than tests in a 1:3 Ottawa sand mortar.

7. In most cases, the fine cement required no more water than the normal cement to produce a given consistency, when the aggregates and mix were the same.

8. It was found that when the special cement was tested for fineness on the 200 mesh sieve, the lumps of very fine material were not broken up under the sieving action and would not pass through the meshes, but when this cement was tested by the air analyzer these lumps were broken up and the results thus secured gave a true indication of the fineness of the cement. It is, therefore, recommended that the air analyzer be used in determining the fineness of very fine cement whenever possible, but that if this can not be done care be taken to prevent this balling on the 200-mesh sieve if the determination is made in the usual manner.

Portland Cement; Effect of Fineness.—The Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill., has published an 81 page report of investigations undertaken to determine the effect of fineness of cement.

The Portland cements used were from seven commercial mills. These plants represent the principal cement-producing districts east of the Mississippi River. Fifty-one different samples of cement were used. The cements were ground at the mill to four to seven degrees of fineness, which gave residues ranging from 2 to 43 per cent on the standard No. 200 sieve. In general, the aggregate consisted of sand and pebbles; in one series blast-furnace slag and a light-weight aggregate consisting of burnt shale were used. This report covers compression tests on 6125 6 by 12 in., concrete cylinders, 9,000 compression and tension tests of mortar, and several thousand miscellaneous tests. Strength tests of concrete and mortar were made at ages of 7 days to one year.

The following may be stated as the principal conclusions from the tests.

1. There is no necessary relation between the strength of concrete and the fineness of the cement, if different cements are considered.

2. In general, the strength of concrete increases with the fineness of a given lot of cement, for all mixes, consistencies, gradings of the aggregate, and ages of concrete. The cements with residues lower than about 10 per cent were inclined to give erratic results in the strength tests; one lot showed an abnormal increase, and two others a pronounced decrease in strength as compared with the other tests on coarser cements in the same lot.

3. For residues higher than 10 per cent the strength of concrete varies approximately inversely as the residue on the No. 200 sieve.

4. Fine grinding of cement is more effective in increasing the strength of lean mixtures than rich ones.

5. Fine grinding of cement is more effective in increasing the strength of concrete at 7 days than at ages of 28 days to 1 year.

6. For the usual range of consistencies, the effect of fineness of cement is independent of the consistency of the

concrete. The rate of increases in strength with fineness is lowered for ver wety mixtures.

7. Ordinary concrete mixtures at 28 days show an increase in strength of about 2 per cent for 1 per cent reduction of the residue of the cement on the No. 200 sieve. At 7 days, 3 months and 1 year the corresponding increases in strength are about 2.5, 1.7 and 1.4 per cent.

8. The decreased benefit of fine grinding of cement with the age of the concrete does not bear out accepted opinion that the coarser particles of cement do not hydrate, but indicates that the principal result of finer grinding is to hasten the early hardening.

9. For the richer mixtures and the consistency necessary for building construction, the fineness of the cement has no appreciable test. For leaner mixtures and wetter consistencies, the finer cements showed somewhat greater "slump" than the coarser cements.

10. The normal consistency of cement is increased with fineness of grinding. About 0.1 per cent of water (in terms of weight of the cement) must be added for each 1 per cent reduction in residue on the No. 200 sieve.

11. The time of setting of cement is shortened with finer grinding. In some instances initial setting time with the Vicat needle was shortened to 5 to 10 minutes.

12. The unit weight of cement decreases with fineness. For the cements used in these tests the weight varies from 76 (residue of 2.4 per cent) to 108 lb. per cu. ft. (residue 43.3 per cent). For the usual range in fineness, the weight is lowered about ¾ lb. per cu. ft. for each 1 per cent reduction in the residue on the No. 200 sieve.

13. In using 94 lb. per cu. ft. as a uniform basis for proportioning the cements in these tests, the actual volume of cement in a batch of the same mix varies about 35 per cent. If the mixtures had been proportioned in a manner that would have given a uniform volume of cement, the resulting concrete strength would not have been so favorable to the finer cements.

14. The fineness of cement has no appreciable effect on the yield or density of concrete.

15. Concrete of all mixes and consistencies showed expansion in damp sand or water storage and contraction in air.

16. The change in length of concrete specimens stored in air or water is independent of the fineness of the cement and the consistency of the concrete. The lean concretes are slightly less affected than the rich mixtures.

17. The type of aggregate has little or no influence on the relative effect of fineness of cement on the strength of concrete.

18. The tests included in this report show an intimate relation between the strength of the concrete and the water-ratio of the mixture. The lower the water-ratio (so long as the concrete is plastic and the aggregate not too coarse) the higher the strength, and vice versa. This confirms the results of other concrete tests made in this Laboratory. Increasing the quantity of cement in a given mixture enables us to secure a concrete of equal workability with a lower water-ratio, hence a higher strength.

19. In ordinary concrete mixtures (say, 1:5 to 1:4, requiring 20 to 25 per cent cement, by volume) increasing the cement content by 1 per cent (to 20.2 per cent for a 1:5 mix) gives an increase in strength of about 1 per cent.

20. One per cent increase in cement is more effective in increasing the strength of concrete in lean than in rich mixtures.

21. One per cent increase in cement is somewhat more effective in increasing the early strength of concrete than at later periods.

22. The effect of increasing the quantity of cement is independent of the consistency of the concrete.

23. Tension tests of briquettes do not give a correct measure of the relative merits of different cements as determined by compression tests of mortar and concrete."

Reinforced Concrete; Standardization of Reinforcing Steel.—In reply to an inquiry from the Structural Service Department we are in receipt of the following digest of the reasons for adopting standard sizes for reinforcing steel:

"Conditions in the steel industry are very serious from the standpoint of supply. The aim is to obtain maximum production. The demand for reinforcing steel is much greater than the supply. Obviously, the fewer number of sizes that are required from the mills, the greater will be their possible production. Also, the various reinforcing steel companies can maintain a more evenly balanced supply of stock on hand. Heretofore, practically every company was attempting to maintain a supply of all sizes of both square and round bars. With the difficulties in securing steel, it was naturally almost impossible to maintain a supply of approximately 20 different sizes. If you cut the number down to 10, it is plainly evident that a larger supply of each size can be kept on hand, with the less likelihood of a shortage of any particular size.

"Now, if you will compare the areas of round bars and square bars varying by ⅛ in., you will find that in many cases they practically duplicate one another. Therefore, the elimination of these sizes will effect no hardship whatever on the designer or builder of reinforced concrete.

"These facts were evident to the War Service Committee of the Industries Board during the war, and the standardization of bar sizes was practically ready for adoption at the time of the signing of the armistice. Naturally, nothing was done about it for some time after the signing of the armistice. The steel situation, however, brought the problem acutely before the reinforcing steel manufacturers with the resulting adoption of the standarized sizes.

"Choice of sizes has been so made as to give the designer every latitude that he has had previously, and so that he is not hampered in any way. On the contrary, a great step in advance has been made for the benefit of the building industry: firstly, because a greater production of reinforcing steel will be made possible by concentrating on these standard sizes; and secondly, because the smaller number of sizes will enable the various companies and local warehouses to maintain a more uniform stock on hand."

The standard sizes adopted are as follows:

Area	*Equivalent to*	*Area*	*Equivalent to*
.110″	⅜″ round	.601″	¾″ round
.196″	1/2″ round	.785″	1″ round
.250″	1/2″ square	1.000″	1″ square
.307″	5/8″ round	1.266″	1-1/8″ square
.442″	3/4″ round	1.563″	1-1/4″ square